BIDDING DOCUMENTS

Project Manual

Public Safety Facility Construction

City of Prairie du Chien, Wisconsin

SEH No. PDCAR 177629

January 26, 2026

SEH

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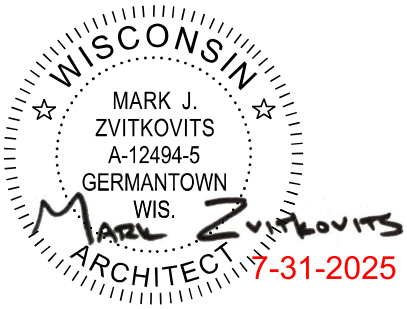
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DOCUMENT 000107 - SEALS PAGE

1.1 DESIGN PROFESSIONALS OF RECORD

A. Architect:

1. Short Elliott Hendrickson Inc.
425 West Water Street, Suite 300
Appleton, WI 54911
Contact: Mark Zvitkovits
Phone: 920.380.2800

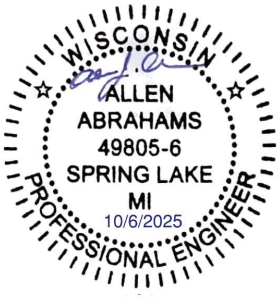


B. Civil Engineer:

1. raSmith.
100 West Lawrence Street, Suite 412
Appleton, WI 54911
Contact: Brad Hartjes
Phone: 920.731.3499

C. Structural Engineer:

1. Short Elliott Hendrickson Inc.
221 West Webster Avenue, Suite 501
Muskegon, MI 49440
Contact: Allen Abrahams
Phone: 231.769.2022



D. Plumbing Engineer:

1. MSA Professional Services, Inc.
12308 Corporate Parkway, Suite 400
Mequon, WI 53092
Contact: Justin Davis
Phone: 262.243.9090

E. HVAC Engineer:

1. MSA Professional Services, Inc.
12308 Corporate Parkway, Suite 400
Mequon, WI 53092
Contact: Randy All
Phone: 262.243.9090

F. Electrical Engineer:

1. MSA Professional Services, Inc.
116 Fremont Street
Kiel, WI 53042
Contact: Laura Gilbert
Phone: 920.894.7800

END OF DOCUMENT 000107

COMcheck Software Version COMcheckWeb

Envelope Compliance Certificate

Project Information

Energy Code:	2015 IECC
Project Title:	Prairie du Chien Public Safety Facility_v2
Location:	Prairie du Chien, Wisconsin
Climate Zone:	6a
Project Type:	New Construction
Vertical Glazing / Wall Area:	3%

Construction Site: Owner/Agent: Designer/Contractor:

Additional Efficiency Package(s)

Credits: 1.0 Required 1.0 Proposed
Enhanced Interior Lighting Controls, 1.0 credit

Building Area	Floor Area
1-Apparatus Bays (Parking Garage) : Nonresidential	12956
2-Offices (Fire Station) : Nonresidential	7412
3-Offices (Police) : Nonresidential	7697
4-Squad Garage (Parking Garage) : Nonresidential	7242

Envelope Assemblies

Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Proposed U-Factor	Budget U-Factor(a)
Roof: Insulation Entirely Above Deck, [Bldg. Use 1 - Apparatus Bays]	12637	---	30.0	0.032	0.032
Roof: Insulation Entirely Above Deck, [Bldg. Use 1 - Apparatus Bays]	162	---	30.0	0.032	0.032
Roof: Insulation Entirely Above Deck, [Bldg. Use 1 - Apparatus Bays]	532	---	30.0	0.032	0.032
Floor: Heated Slab-On-Grade Fully Insulated (user specified perimeter R-value + R-15.0 under slab), [Bldg. Use 1 - Apparatus Bays] (c)	280	---	15.0	0.450	0.790
Floor: Heated Slab-On-Grade Fully Insulated (user specified perimeter R-value + R-15.0 under slab), [Bldg. Use 1 - Apparatus Bays] (c)	126	---	0.0	0.820	0.790
Roof: Insulation Entirely Above Deck, [Bldg. Use 2 - Offices]	2185	---	30.0	0.032	0.032
Roof: Insulation Entirely Above Deck, [Bldg. Use 2 - Offices]	2683	---	30.0	0.032	0.032
Floor: Unheated Slab-On-Grade, Horizontal with vertical 4 ft., [Bldg. Use 2 - Offices] (c)	201	---	15.0	0.630	0.540
Roof: Insulation Entirely Above Deck, [Bldg. Use 3 - Offices]	7391	---	30.0	0.032	0.032
Floor: Unheated Slab-On-Grade, Horizontal with vertical 4 ft., [Bldg. Use 2 - Offices] (c)	112	---	15.0	0.630	0.540
Floor: Unheated Slab-On-Grade, Horizontal with vertical 4 ft., [Bldg. Use 4 - Squad Garage] (c)	216	---	15.0	0.630	0.540
Floor: Unheated Slab-On-Grade, Horizontal with vertical 4 ft., [Bldg. Use 4 - Squad Garage] (c)	30	---	0.0	0.730	0.540
Roof: Insulation Entirely Above Deck, [Bldg. Use 4 - Squad Garage]	139	---	30.0	0.032	0.032
Roof: Other Metal Building Roof, [Bldg. Use 4 - Squad	7260	---	---	0.031	0.031

Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Proposed U-Factor	Budget U-Factor(a)
Garage] (b)					
NORTH					
Ext. Wall: Solid Concrete, 6in. Thickness, Normal Density, Furring: Metal, [Bldg. Use 2 - Offices]	156	0.0	15.0	0.057	0.080
Ext. Wall: Steel-Framed, 16in. o.c., [Bldg. Use 2 - Offices]	175	0.0	15.0	0.056	0.064
Ext. Wall: Solid Concrete, 6in. Thickness, Normal Density, Furring: None, [Bldg. Use 1 - Apparatus Bays]	2265	---	15.0	0.060	0.080
Door: Insulated Metal, Swinging, [Bldg. Use 1 - Apparatus Bays]	24	---	---	0.200	0.370
Ext. Wall: Solid Concrete, 6in. Thickness, Normal Density, Furring: Metal, [Bldg. Use 3 - Offices]	369	0.0	15.0	0.057	0.080
Door: Insulated Metal, Swinging, [Bldg. Use 3 - Offices]	24	---	---	0.200	0.370
Ext. Wall: Solid Concrete, 6in. Thickness, Normal Density, Furring: None, [Bldg. Use 4 - Squad Garage]	187	---	15.0	0.060	0.080
Door: Insulated Metal, Swinging, [Bldg. Use 4 - Squad Garage]	34	---	---	0.200	0.370
Ext. Wall: Other Metal Building Wall, [Bldg. Use 4 - Squad Garage] (b)	1329	---	---	0.044	0.052
Door: Insulated Metal, Non-Swinging, [Bldg. Use 4 - Squad Garage]	80	---	---	0.150	0.179
EAST					
Ext. Wall: Solid Concrete, 6in. Thickness, Normal Density, Furring: None, [Bldg. Use 2 - Offices]	332	---	15.0	0.060	0.080
Window: Metal Frame with Thermal Break: Fixed, Perf. Specs.: NFRC CPD-ID P-KAW-47861, SHGC 0.35, [Bldg. Use 2 - Offices]	48	---	---	0.436	0.360
Ext. Wall: Solid Concrete, 6in. Thickness, Normal Density, Furring: None, [Bldg. Use 1 - Apparatus Bays]	3444	---	15.0	0.060	0.080
Door: Insulated Metal, Swinging, [Bldg. Use 1 - Apparatus Bays]	24	---	---	0.200	0.370
Door: Insulated Metal, Non-Swinging, [Bldg. Use 1 - Apparatus Bays]	588	---	---	0.150	0.179
Ext. Wall: Steel-Framed, 16in. o.c., [Bldg. Use 3 - Offices]	210	0.0	15.0	0.056	0.064
Ext. Wall: Other Metal Building Wall, [Bldg. Use 4 - Squad Garage] (b)	1977	---	---	0.044	0.052
Door: Insulated Metal, Swinging, [Bldg. Use 4 - Squad Garage]	24	---	---	0.200	0.370
SOUTH					
Ext. Wall: Solid Concrete, 6in. Thickness, Normal Density, Furring: Metal, [Bldg. Use 2 - Offices]	735	0.0	15.0	0.057	0.080
Door: Insulated Metal, Swinging, [Bldg. Use 2 - Offices]	24	---	---	0.200	0.370
Ext. Wall: Solid Concrete, 6in. Thickness, Normal Density, Furring: None, [Bldg. Use 1 - Apparatus Bays]	1018	---	15.0	0.060	0.080
Door: Insulated Metal, Swinging, [Bldg. Use 1 - Apparatus Bays]	41	---	---	0.200	0.370
Ext. Wall: Solid Concrete, 6in. Thickness, Normal Density, Furring: Metal, [Bldg. Use 3 - Offices]	1399	0.0	15.0	0.057	0.080
Window: Metal Frame with Thermal Break: Fixed, Perf. Specs.: NFRC CPD-ID P-KAW-47861, SHGC 0.35, [Bldg. Use 3 - Offices]	184	---	---	0.436	0.360
Ext. Wall: Other Metal Building Wall, [Bldg. Use 4 - Squad Garage] (b)	1329	---	---	0.044	0.052
Door: Insulated Metal, Non-Swinging, [Bldg. Use 4 - Squad Garage]	160	---	---	0.150	0.179
WEST					
Ext. Wall: Solid Concrete, 6in. Thickness, Normal Density, Furring: Metal, [Bldg. Use 2 - Offices]	2236	0.0	15.0	0.057	0.080
Door: Glass (over 50% glazing): Metal Frame, Entrance Door, Perf. Specs.: NFRC CPD-ID P-KAW-87013, SHGC 0.16, [Bldg. Use 2 - Offices]	24	---	---	0.506	0.770
Window: Metal Frame with Thermal Break: Fixed, Perf. Specs.: NFRC CPD-ID P-KAW-47861, SHGC 0.35, [Bldg. Use 2 - Offices]	383	---	---	0.436	0.360
Ext. Wall: Solid Concrete, 6in. Thickness, Normal Density, Furring: None, [Bldg. Use 1 - Apparatus Bays]	3465	---	15.0	0.060	0.080
Door: Insulated Metal, Non-Swinging, [Bldg. Use 1 - Apparatus	1176	---	---	0.150	0.179

Assembly	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Proposed U-Factor	Budget U-Factor(a)
Bays]					
Ext. Wall: Other Metal Building Wall, [Bldg. Use 4 - Squad Garage] (b)	264	---	---	0.044	0.052

(a) Budget U-factors are used for software baseline calculations ONLY, and are not code requirements.
(b) 'Other' components require supporting documentation for proposed U-factors.
(c) Slab-On-Grade proposed and budget U-factors shown in table are F-factors.

Envelope PASSES: Design 11% better than code

Envelope Compliance Statement

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

Mark Zvitkovits - Architect	Mark Zvitkovits	7-31-2025
Name - Title	Signature	Date

WISCONSIN
MARK J.
ZVITKOVITS
A-12494-5
GERMANTOWN
WIS.
ARCHITECT
Mark Zvitkovits
7-31-2025

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DOCUMENT 000115 - LIST OF DRAWING SHEETS

1.1 LIST OF DRAWINGS

A. Drawings: Drawings consist of the Contract Drawings and other drawings listed on the Table of Contents page of the separately bound drawing set titled Prairie du Chien Public Safety Facility, dated January 25, 2025, as modified by subsequent Addenda and Contract modifications.

END OF DOCUMENT 000115

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DOCUMENT 00 11 13

ADVERTISEMENT FOR BIDS

Public Safety Facility Construction
City of Prairie du Chien, Wisconsin
SEH No. PDCAR 177629

Notice is hereby given that Online Bids will be received by the City of Prairie du Chien until 2:00 p.m., Tuesday, March 10, 2026, via QuestCDN for the furnishing of all labor and material for the construction of the Prairie du Chien Public Safety Building. Bids will be on lump sum basis

The bid opening will be conducted via Microsoft Teams, at which time they will be publicly opened and read aloud:

Please join my meeting from your computer, tablet or smartphone: *https://bit.ly/PDCPublicPublicSafetyFacConst*

Or call in (audio only)
+1 872-242-7640 United States, Chicago
Phone Conference ID: 929 525 886#

Any person monitoring the meeting remotely may be responsible for any documented costs. Message and data rates may apply.

Work includes: Construction of a new Police and Fire Station.

The Issuing Office for the Bidding Documents is: Short Elliott Hendrickson Inc. located at425 West Water Street, Suite 300, Appleton, WI 54911-6058, 920.380.2800, Mark Zvitkovits, AIA, at 920.380.2847, mzvitkovits@sehinc.com

The Bidding Documents may be viewed for no cost at http://www.sehinc.com by selecting the Project Bid Information link at the bottom of the page and the View Plans option from the menu at the top of the selected project page.

Digital image copies of the Bidding Documents are available at http://www.sehinc.com for a fee of $30. These documents may be downloaded by selecting this project from the “Project Bid Information” link and by entering eBidDoc™ Number 10060782 on the SEARCH PROJECTS page. For assistance and free membership registration, contact QuestCDN at 952.233.1632 or info@questcdn.com.

For this project, bids will **ONLY** be received electronically. Contractors submitting an electronic bid **will** be charged an additional $42 at the time of bid submission via the online electronic bid service QuestCDN.com. To access the electronic Bid Worksheet, download the project document and click the online bidding button at the top of the advertisement. Prospective bidders must be on the plan holders list through QuestCDN for bids to be accepted. Bids shall be completed according to the Bidding Documents prepared by SEH dated January 26, 2026.

Bid security in the amount of 5 percent of the Bid must accompany each Bid in accordance with the Instructions to Bidders.

The successful Bidder will be required to provide Performance and Payment Bonds of 100 percent of bid amount.

The City reserves the right to reject any and all Bids, to waive irregularities and informalities therein and to award the Contract in the best interests of the City.

Chad Abrams
City Administrator
City of Prairie du Chien

DOCUMENT 002113 - INSTRUCTIONS TO BIDDERS

1.1 INSTRUCTIONS TO BIDDERS

A. AIA Document A701, "Instructions to Bidders," is hereby incorporated into the Procurement and Contracting Requirements by reference.

END OF DOCUMENT 002113

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DOCUMENT 002600 - PROCUREMENT SUBSTITUTION PROCEDURES

1.1 DEFINITIONS

A. Procurement Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Procurement and Contracting Documents, submitted prior to receipt of bids.

B. Substitution Requests: Requests for changes in products, materials, equipment, and methods of construction from those indicated in the Contract Documents, submitted following Contract award. See Section 012500 "Substitution Procedures" for conditions under which Substitution requests will be considered following Contract award.

1.2 QUALITY ASSURANCE

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

1.3 PROCUREMENT SUBSTITUTIONS

A. Procurement Substitutions, General: By submitting a bid, the Bidder represents that its bid is based on materials and equipment described in the Procurement and Contracting Documents, including Addenda. Bidders are encouraged to request approval of qualifying substitute materials and equipment when the Specifications Sections list materials and equipment by product or manufacturer name.

B. Procurement Substitution Requests will be received and considered by Owner when the following conditions are satisfied, as determined by Architect; otherwise requests will be returned without action:

1. Extensive revisions to the Contract Documents are not required.
2. Proposed changes are in keeping with the general intent of the Contract Documents, including the level of quality of the Work represented by the requirements therein.
3. The request is fully documented and properly submitted.

1.4 SUBMITTALS

A. Procurement Substitution Request: Submit to Architect. Procurement Substitution Request must be made in writing in compliance with the following requirements:

1. Requests for substitution of materials and equipment will be considered if received no later than 10 days prior to date of bid opening.
2. Submittal Format: Submit one copy of each written Procurement Substitution Request, using CSI Substitution Request Form 1.5C.

B. Architect's Action:

1. Architect may request additional information or documentation necessary for evaluation of the Procurement Substitution Request. Architect will notify all bidders of acceptance of the proposed substitute by means of an Addendum to the Procurement and Contracting Documents.

C. Architect's approval of a substitute during bidding does not relieve Contractor of the responsibility to submit required shop drawings and to comply with all other requirements of the Contract Documents.

END OF DOCUMENT 002600

DOCUMENT 003132 - GEOTECHNICAL DATA

1.1 GEOTECHNICAL DATA

A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information. This Document and its attachments are not part of the Contract Documents.

B. Because subsurface conditions indicated by the soil borings are a sampling in relation to the entire construction area, and for other reasons, the Owner, the Architect, the Architect's consultants, and the firm reporting the subsurface conditions do not warranty the conditions below the depths of the borings or that the strata logged from the borings are necessarily typical of the entire site. Any party using the information described in the soil borings and geotechnical report shall accept full responsibility for its use.

C. A geotechnical investigation report for Project, prepared by Professional Service Industries, Inc., dated May 7, 2024, is available for viewing as appended to this Document.

1. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from the data.
2. Any party using information described in the geotechnical report shall make additional test borings and conduct other exploratory operations that may be required to determine the character of subsurface materials that may be encountered.

D. Related Requirements:

1. Document 002113 "Instructions to Bidders" for the Bidder's responsibilities for examination of Project site and existing conditions.

END OF DOCUMENT 003132

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Professional Service Industries, Inc.
821 Corporate Court, Waukesha, WI 53189
Phone: (262) 521-2125
Fax: (262) 521-2471

May 7, 2024

Short Elliott Hendrickson
425 W. Water St., Suite 300
Appleton, WI 54911

Attn: Mr. Trevor Frank
Senior Architect

Re: Geotechnical Exploration and Evaluation
Proposed Public Safety Building
E. Taylor St. and S. Dousman St.
Prairie du Chien, WI
PSI Project No. 00523381

Dear Mr. Frank:

The geotechnical exploration and evaluation for the referenced project has been completed. An electronic copy of the report is being provided via email. Paper copies can be issued upon request. After you have had the opportunity of reading the report, please call at any time with any questions or comments you may have. Professional Service Industries, Inc. (PSI), an Intertek Company, appreciates the opportunity to be of service on this project, and looks forward to continuing as your geotechnical consultant during the design and construction phases, as well as your upcoming projects.

Sincerely,

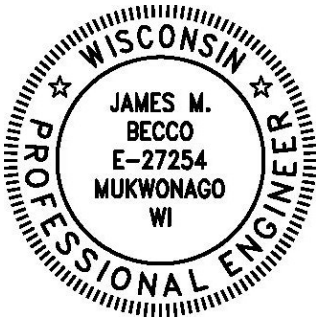
PROFESSIONAL SERVICE INDUSTRIES, INC.

Nicole Carlson
Department Manager
Geotechnical Services

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REVISED GEOTECHNICAL EXPLORATION AND EVALUATION

For the:

Proposed Public Safety Building
E. Taylor St. and S. Dousman St.
Prairie du Chien, WI

Prepared for:

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INTRODUCTION

General

This report presents the results of the geotechnical exploration and evaluation for the proposed Prairie du Chien Public Safety Facility project located in Prairie du Chien, Wisconsin. The work was performed for Short Elliott Hendrickson, at the request of Mr. Trevor Frank.

Purpose

The purpose of this study was to evaluate the subsurface conditions at specific boring locations on the site, and to establish parameters for use by the design engineers and architects in preparing the foundation, floor slab, stormwater management, and pavement designs for the proposed project.

Scope

The scope of services included the subsurface exploration, an evaluation of soil characteristics by field and laboratory testing, and an evaluation of the data obtained. Subgrade preparation recommendations and construction considerations are also provided. The scope of the field work, including the number, location, and depth of the borings was determined by Short Elliott Hendrickson.

Authorization

The description of services and authorization to perform this geotechnical exploration and evaluation were in the form an Short Elliott Hendrickson Subcontract, dated March 27, 2024, which included PSI Proposal No. 420760, dated March 25, 2024. This report has been prepared on behalf of, and exclusively for the use of Short Elliott Hendrickson. The information contained in this report may not be relied upon by any other parties without the express written consent of PSI, and acceptance by such parties of PSI's General Conditions.

SITE AND PROJECT DESCRIPTION

Site Features

The project site is located at the northeast corner of E. Taylor St. and S. Dousman St., in Prairie du Chien, Wisconsin. At the time of the exploration, the property was vacant and grass covered. It is understood that the parcel was previously occupied by a large medical complex. The surrounding parcels were generally developed with commercial and residential structures. Aerial photos of various years between 1994 and 2020 reviewed on Google Earth indicate that at the time of the earliest photo, the site was occupied by the previous medical complex and associated paved areas, which covered most of the property. The site remains relatively similar

in appearance through the 2013 photo. In the 2019 photo, the medical complex is no longer present, and the site is grass covered. However, several of the photos were grainy, and details were difficult to discern. The subject site is depicted on the enclosed Boring Location Plan (Figure 1).

The topography of the general area is relatively flat, sloping down to the west, with an elevation difference of approximately 2 feet (EL. 639 to EL. 637).

Project Description

Based on information provided by the client, it is understood that the proposed project will consist of an approximately 37,000 square foot one-story, slab-on-grade structure. No basement is planned. The structure will be supported by conventional spread footings. It is understood that the maximum column and wall load will be 80 kips and 10 klf, respectively. A finished floor elevation was not provided. For the purpose of this report, it is estimated that the floor will be at about EL. 638.5, and that only nominal cuts and fills of up to about 1 foot will be required.

Pavements for this project are understood to consist of asphalt and/or concrete parking lots and driveways. Traffic loading was not provided.

Two stormwater management areas are proposed within the northwest (B-1) and southwest (B-2) corner of the property. The type, size, bottom elevation, and other design details of the stormwater management area have not been provided.

When additional information becomes available and/or if any of the information provided herein is incorrect or changes, PSI must be informed so that any necessary re-evaluation or revisions to this report can be made.

EXPLORATION AND LABORATORY PROCEDURES

Scope Summary

The field and laboratory data utilized in the evaluation of the subsurface materials was obtained by drilling exploratory test borings, securing soil samples by the split-spoon sampling method, and subjecting the samples to standard laboratory testing.

With respect to the stormwater management areas, the field and laboratory work for classification of the subgrade soils was performed to provide information for use by the basin design personnel when considering requirements of Chapter NR151 of the Wisconsin Administrative Code, WDNR Technical Standard 1002 (Site Evaluation for Stormwater Infiltration), or other applicable local or state guidelines/regulations/requirements. The design

of the proposed stormwater management area was beyond the scope of services for this project.

Field Exploration

Ten (10) soil borings were drilled for this project. Borings B-1 and B-2 were drilled within planned stormwater areas to a depths of about 27 and 25 feet. The remaining borings were performed within building and pavement areas to depths of about 15 to 30 feet. The number, depths, and locations of the borings were determined by the client. The borings were located in the field by the drill crew utilizing a consumer grade GPS device. They are estimated to be accurate to within several feet. The surface elevations shown on the logs were estimated by interpolation of a 1-foot contour map of the property, provided by the client. The elevations are estimated to be accurate to within about 1 foot.

The soil test borings were performed with an all-terrain (ATV) mounted drilling rig utilizing continuous flight hollow stem augers to advance the holes. Representative samples were obtained by the Standard Penetration Test (SPT) method using split-spoon sampling in general accordance with ASTM D-1586 procedures. Samples were secured at 2.5-foot intervals to a depth of 10 feet, and then at 5-foot intervals thereafter to the end of the borings. As an exception, samples were obtained at 2-foot intervals at the borings performed within the proposed stormwater management areas. The standard penetration value (N) is defined as the number of blows of a 140-pound hammer, falling thirty (30) inches, required to advance the split-spoon sampler one (1) foot into the soil. The sampler is lowered to the bottom of the drill hole and the number of blows recorded for each of the three (3) successive increments of six (6) inches penetration. The “N” value is obtained by adding the second and third incremental numbers. The SPT provides a means of estimating the relative density of granular soils and comparative consistency of cohesive soils, thereby providing a method of evaluating the relative strength and compressibility characteristics of the subsoils.

The SPT soil samples were transferred into clean glass jars immediately after retrieval and returned to the laboratory upon completion of the field operations. Samples will be discarded unless other instructions are received. The soil samples were visually classified in general accordance with the Unified Soil Classification System. As an exception, the samples from B-1 and B-2 were visually classified by a certified soil tester in general accordance with USDA National Resources Conservation Service textural soil classification procedures. A description of the subsurface conditions encountered at each boring location is shown on the enclosed Soil Boring Logs. After completion of the borings, the auger holes were backfilled to the ground surface with bentonite chips.

A copy of the Soil Boring Logs and Boring Location Plan (Figure 1) are enclosed in the Appendix. The soil stratification shown on the logs represents the approximate soil conditions in the actual boring locations at the time of the exploration. The terms and symbols used on the logs are described in the General Notes found in the Appendix.

Laboratory Physical Testing

Soil samples obtained from the exploration were visually classified in the laboratory, and subjected to testing, which included moisture content determinations. Selected cohesive soil samples were tested in unconfined compression with a controlled strain loading rate and/or with a calibrated hand penetrometer to aid in evaluating the soil strength characteristics. The values of strength tests performed on soil samples obtained by the Standard Penetration Test Method (SPT) are considered approximate, recognizing that the SPT method provides a representative but somewhat disturbed soil sample

The laboratory testing was performed in general accordance with the respective ASTM methods, as applicable, and the results are shown on the boring logs in the Appendix.

DESCRIPTION OF SUBSURFACE CONDITIONS

General

A description of the subsurface conditions encountered at the test boring locations is shown on the Soil Boring Logs. The lines of demarcation shown on the logs represent an approximate boundary between the various soil classifications. It must be recognized that the soil descriptions are considered representative estimates for the specific test hole location, but those variations may occur between and beyond the sampling intervals and boring locations. Soil depths, topsoil, and layer thicknesses, and demarcation lines utilized for preconstruction planning should not be expected to yield exact and final quantities. A summary of the major soil profile components is described in the following paragraphs.

Soil Conditions

USCS Classification (B-3 through B-10)

The surficial materials at the borings consisted of about 5 to 12 inches of silt and sand topsoil predominantly classified as fill. As an exception, a discernible topsoil layer was not present at B-6. The underlying soils at B-4, B-5, B-7, B-8, and B-10; and the materials extending from the surface at B-6 consisted of brown to dark brown sand or sand and gravel fill to a depth of about 3 feet (EL 635 to EL. 636). Some of the fill samples contained concrete, brick and wood fragments. The underlying natural soils at these locations, and extending from the surface at B-3 and B-9 consisted predominantly of fine to medium or fine to coarse sand with varying gravel content. The granular fill soils were in a loose to medium dense condition with N-values between 3 and 14 blow per foot. The natural granular soils were also in a loose to medium dense condition with N-values between 5 and 12.

USDA Classification (B-1 and B-2)

The materials extending from the surface at B-1 consisted of gravelly loamy sand, sand, very and gravelly medium sand classified as fill to a depth of about 11.5 feet (EL. 626.5). The

materials extending from the surface at B-2 consisted of silty clay loam and sandy loam classified as fill to a depth of about 12.5 feet (EL. 624.5). The underlying soils consisted of medium sand, fine to medium sand, sandy loam, and gravelly sandy loam.

The foregoing discussion of soil conditions on this site represents a generalized soil profile as determined at the test boring locations. A more detailed description and supporting data for each test location can be found on the individual Soil Boring Logs.

Groundwater Observations

Groundwater observations were made during the drilling operations, and in the open boreholes at completion. Groundwater was encountered during auger advancement in borings B-1, B-2, B-6, B-7, B-8, B-9, and B-10 at depths ranging from 22 to 23.5 feet (EL. 617 to EL. 614.5) below existing grade. Groundwater was not present upon completion at these borings, and was not encountered at the remaining borings. All of the holes caved to varying depths upon withdrawal of the auger; therefore, observations could not be made below the caved depth.

The groundwater observations reported herein are considered approximate. It must be recognized that groundwater levels fluctuate with time due to variations in seasonal precipitation, lateral drainage conditions, and soil permeability characteristics. Longer-term monitoring would be required and is recommended to further evaluate groundwater levels on this site.

EVALUATION AND RECOMMENDATIONS

General Development Considerations

In view of the subsurface conditions encountered in the test borings, together with the structural loading criteria and development grades anticipated, conventional spread footings, along with conventional slab-on-grade construction, can be used for support of the proposed structure. Fill soils were encountered in several of the building borings to a depth of about 3 feet (EL. 635 to EL. 636) below the existing surface. Fill soils are not suitable for support and all foundations must be extended to bear upon underlying suitable natural soils. Based on the estimated floor elevation, undercuts of up to about 2 feet may be necessary for interior footings. Some nominal undercutting may also be necessary for frost depth footings. However, some variation is likely. Some difficulty with excavation and subgrade stability may be experienced.

The existing soils can be utilized for support of the floor slab and pavements after proper subgrade preparation. However, some over-excavation of unsuitable soils may be necessary, especially within existing fill. Asphalt and concrete pavement can be used in the parking lot and driveway areas.

A discussion of the building foundation and pavement design parameters, as well as the support conditions for the floor slab and pavement are included in later sections.

Site Preparation and Grading

The presence of organic topsoil and vegetation in the subgrade can adversely affect the serviceability of structural fills, foundations, floor slabs, pavements, and other structures placed upon them. Approximately 5 to 12 inches of topsoil and topsoil fill were present on the surface of the site at most of the boring locations. However, some variation should be expected. All topsoil, vegetation, trees, roots, and other organic matter must be stripped from the areas of footings, floor slabs, pavements, sidewalks, and other structures.

Site preparation will require removal of the remnants of former buildings, including foundations and underground utilities. Extensive areas of loose backfill material may be encountered within former utility trenches, and in the former building, basement, and other structural areas. These will also require removal. The areas, including basements, must then be properly backfilled with compacted structural fill. Prior to the backfilling, the areas must be observed by a PSI representative to evaluate the suitability of the subgrade for subsequent support of the new building, utilities, or other structures.

After stripping the topsoil and cutting high areas of the site to the planned finished grade, and prior to the placement of new fill which may be placed to raise grades, the subgrade must be thoroughly proofrolled to detect unstable, yielding soils. This should consist of overlapping passes in a perpendicular grid pattern, with a fully-loaded tandem-axle dump truck, or other equipment of similar size and weight suitable for the surface conditions. Proofrolling should be performed in consultation with the geotechnical engineer at the time of construction. Removal of loose, unstable or otherwise unsuitable soils may be necessary, and may become extensive in areas of existing fill. Some difficulty with subgrade preparation may be experienced, especially in wet or cold weather, or during thawing conditions. Additionally, instability can become more severe in silty and clayey materials, which are considered to be moderately to highly moisture sensitive. It is generally recommended that earthwork be carried out during relatively warm, dry weather. Any soft, wet, or otherwise unstable zones which cannot be improved by scarification and aeration, must be removed and replaced with compacted structural fill, such as clean crushed stone, possibly in conjunction with the use of a geotextile fabric. Construction delays and difficulty with subgrade stabilization may be experienced during periods of wet and/or cool weather.

Every effort must be made to keep excavations dry. If construction proceeds during wet weather, some additional over-excavation may be necessary. If weather permits, the soil could be dried and recompacted. A crushed stone working mat, possibly in conjunction with a geotextile fabric, may also be feasible to help stabilize subgrades. Site grading runoff should be directed to catch basins, so that the potential for the softening of the foundation subgrade soils is reduced.

Where site grades are raised in excess of 2 feet, the first lift of new fill must be placed so as to extend a minimum lateral distance of 5 feet beyond the planned top building pad dimension (for fills less than 5 feet in thickness), or for a distance equal to at least 1 foot laterally beyond the top pad dimension for every foot of fill thickness (for fills greater than 5 feet in depth). Subsequent lifts can then be placed on an approximate 1H:1V slope back up to the planned top perimeter dimension of the pad. Similarly, where undercutting of unsuitable soils is performed beneath foundations, floor slabs, or other structural areas, it is recommended that the removal extend laterally beyond the perimeter of the structure at least 1 foot for every foot of removal below the planned bearing depth. Proper moisture control is essential to reduce the amount of compactive effort necessary to achieve the desired densities. In addition, proper placement, and compaction of new fill to raise grades is essential for proper foundation support.

When a firm and stable subgrade is established, low areas may be raised to planned grades with properly compacted structural fill. Any new fill should be a clean granular soil or a low-plasticity cohesive soil. If fine-grained soils, such as those with high silt or clay content are used, they should generally be placed over large open areas, where conditions are more favorable for the proper placement and compaction of such materials. It must be recognized that high silt or clay content materials are difficult to compact when placed at moisture contents beyond a few percent of the optimum moisture content. In addition, the near surface silty soils on this site are generally considered to be moisture sensitive; therefore, some difficulty with subgrade preparation should be expected, especially if they become wet during construction. Fill must be placed in layers of not more than nine (9) inches in thickness, at moisture contents at or near optimum, and be compacted to a minimum density of 95 percent of the maximum dry density as determined by ASTM designation D-698 (Standard Proctor). Silt, clay and wet granular soils are not suitable for reuse as compacted fill in trenches, or adjacent to foundation stem walls or retaining walls.

Proper moisture control is essential to reduce the amount of compactive effort necessary to achieve the desired densities. This is especially true of clayey soils, where scarification and aeration may be required to achieve near-optimum moisture levels prior to compaction. A sheepsfoot roller is generally required for compaction of clayey soils, whereas a vibratory smooth drum roller is preferred for granular material. Small hand-operated compactors should be used in confined areas; granular fills are generally more readily compacted to the required densities in such applications.

It is recommended that well-graded granular soils be utilized as backfill in new utility trenches and alongside below grade walls to reduce the potential for consolidation and settlement of the fill. All fill soils must be placed and compacted under engineering-controlled conditions, to provide suitable support for overlaying structures and roadways. Additional guidance can be provided at the time of construction in the selection process for grade-raising fill and trench backfill.

The selection of fill materials for various applications should be done in consultation with the soils engineer. Similarly, the evaluation of the subgrade and placement and compaction of fill

for structural applications should be monitored and tested by a qualified representative of the soils engineer.

Foundation Evaluation

The proposed structure may be supported by a conventional spread foundation system, bearing on suitable naturally occurring soils or within structural fill, prepared as discussed in a previous section. Based upon the estimated floor elevation (EL. 638.5), interior and exterior footings will bear at about EL. 637 and EL. 634.5, respectively. However, existing fill soils were encountered in several of the building borings to a depth of about 3 feet (EL. 635 to EL. 636) below the existing surface. Fill soils are not suitable for support and all foundations must be extended through such materials and any buried topsoil to bear upon underlying suitable natural soils. Undercuts of up to about 2 feet may be necessary for interior footings. Some nominal undercutting may also be necessary for frost depth footings. However, some variation is likely. Conventional spread footings bearing upon suitable natural soils, or upon compacted structural fill (or lean concrete mix), may be designed for a net allowable soil pressure of 2,000 psf. However, some undercutting of loose, unstable, or otherwise unsuitable soils is likely to be necessary.

The suitability of the existing soils for support of the proposed foundation must be determined by testing by a qualified geotechnical engineer during construction, utilizing static cone penetrometer tests or dynamic cone penetrometer tests for cohesive and granular soils, respectively. Soft, loose, or otherwise unsuitable materials, not disclosed by the borings, may be encountered in the foundation excavations at the bearing elevation. If unsuitable existing soil is present, it must be removed throughout a zone extending one foot laterally for each two feet removed below the foundation, on either side of the planned footing. The over-excavated area must be backfilled with structural compacted fill.

In lieu of the use of compacted structural fill, lean concrete mix can be used to replace the unsuitable soils. The foundation excavations should be about 4 inches wider than the proposed footing width and must extend to suitable natural bearing soils. The concrete must be placed immediately after excavation to avoid intrusion of soil into the excavation. The concrete should contain sufficient aggregate and cement to attain a 28-day compressive strength of at least 1000 psi. Some sloughing or caving of the overlying soils may be experienced. Should this occur during concrete placement, the area must be removed and recast. Additionally, should caving become extensive (such as can more typically occur within granular or soft clay soil), it may be necessary to substantially widen excavations to avoid soil intrusion into the concrete. This may result in the use of additional concrete quantities significantly in excess of preconstruction budget estimates.

All perimeter footings and footings in poorly heated or unheated areas must be placed at a depth of at least four (4) feet (or deeper if required by local code or in accordance with customary practice) below the finished exterior grade for frost protection. All footings must be

protected from the effects of frost if construction is carried out during winter months. Interior footings not subject to frost action may be placed at a shallower depth of at least eighteen (18) inches below the floor slab, provided they bear on suitable natural soils or engineered fills.

It is recommended that the footings supporting individual columns have a minimum dimension of 24 inches, and continuous footings have a minimum width of 18 inches, even if the maximum recommended allowable bearing pressure is not fully utilized. In order to minimize the effects of any slight differential movement that may occur due to variations in the character of the supporting soils and any variations in seasonal moisture contents, it is recommended that all foundations be suitably reinforced to make them as rigid as needed.

In general, the performance of the foundation system on this site is dependent on the various factors discussed herein. The excavation, preparation, and concreting of foundations should be monitored and tested by a representative of the soils engineer.

Floor Slab Subgrade

Prior to constructing the floor slabs or pavements, and prior to the placement of any fill used to raise grades, the exposed subgrade must be prepared utilizing the proofrolling procedures described previously. In areas that exhibit soft, yielding or unstable soil conditions, the following remedial measures are recommended to provide a stable subgrade. It must be recognized that the high silt and clay content soils are highly sensitive to increases in moisture and construction disturbance. It will therefore be necessary to maintain these materials in a relatively dry condition to allow for proper subgrade preparation. It is recommended that the proofrolling operations be monitored by a representative of the geotechnical engineer to ensure that a firm, suitable subgrade is present prior to placement of new fills, or to construction of floor slabs and pavements.

Localized wet, soft or unstable areas can be undercut to such depths determined necessary in the field to reach stable material, and the area backfilled with imported crushed stone, such as the 1¼-inch gradation specified in Section 305 of the WisDOT Standard Specifications, placed and compacted as recommended in the Site Preparation section of this report. If relatively thick zones or areas of extensive yielding are observed, and they cannot be stabilized by normal discing, aeration and recompaction procedures, undercutting and replacement with crushed stone and geotextile fabric (if needed) may also be required in these areas.

The floor slab(s) may be designed utilizing an estimated modulus of subgrade reaction of 175 pci based on the presence of suitable and stable granular soils, prepared as discussed in this report. However, this is based on common range values obtained from 1 ft. x 1 ft. plate load tests on specific soil types. Depending on how the slab load is applied, the value may need to be modified for larger areas using the following:

Modulus of Subgrade Reaction $k_s = (\frac{k}{B})$ for cohesive soil

$k_s = k\,(\frac{B+1}{2B})^2$ for cohesionless soil

where: k_s = coefficient of vertical subgrade reaction for loaded area
k = coefficient of vertical subgrade reaction for a 1x1 foot square area
B = width of area loaded, in feet

The final design and detailing should be performed by a qualified structural engineer based on the intended slab use, loading conditions and anticipated subgrade conditions.

A granular mat, which can be designed as a drainage layer, should be provided below the floor slab. This must be a minimum of six (6) inches in thickness and properly compacted. In moisture sensitive areas, a vapor retarder may be placed beneath the floor slab or base course, however, it is recommended that the architect be consulted in this regard. The proper use of a vapor retarder may not completely prevent moisture beneath or on top of slabs. If the base course contains sharp particles, a cushion layer of sand approximately 2 inches in thickness may be required to provide protection from puncture.

The floor slabs should be suitably reinforced to make them as rigid as necessary and proper joints provided at the junction of slabs and the foundation system so that a small amount of independent movement can occur without causing damage. Large floor areas must be provided with joints at frequent intervals (maximum spacing of 30 times the slab thickness, per ACI) to compensate for concrete volume changes (shrinkage). It is recommended that appropriate construction methods and curing procedures be used to minimize shrinkage and curling of the floor slabs.

Exterior/Unheated Area Slabs

Based on the borings, entry slabs, sidewalks, aprons, and other slabs in exterior or unheated areas will predominantly bear upon sand soils. Such materials are not considered to be highly frost susceptible. However, it must be noted that slabs placed directly upon more frost susceptible soils, such as those with high silt or clay content, are subject to heaving and subsequent settlement due to freeze/thaw cycles. This can result in cracking, misalignment, and other related effects (especially at joints). If more fine-grained soils are encountered in areas beyond the borings, or are used to raise grades, it is recommended that consideration be given to limited undercutting of frost susceptible materials, where encountered, to a depth of 1 to 2 feet below the slab, and replacement with well graded, properly placed and compacted granular soils. A properly designed underdrain system connected to the municipal sewer (if permissible) or directed to on-site stormwater management areas should also be incorporated to reduce the potential effects of freeze/thaw cycles.

Utility Construction

In general, the on-site soils can be used for support of utility lines. However, some undercutting of soft, loose, unstable, or otherwise unsuitable or unstable soils, in conjunction with the

placement of crushed stone or other suitable granular backfill may be necessary, especially within existing fill. Some difficulty with the stability of utility trenches may be experienced, especially in the presence of water. The use of shoring, bracing, or trench boxes will be required.

All fill soils must be properly placed and compacted under engineering-controlled conditions to provide suitable support for overlaying structures and roadways. Silty and clayey soils, organic soils, and wet materials are not recommended for use as backfill within utility trenches due to the substantial difficulty of obtaining proper compaction in confined areas.

As with all excavation work, all open cut trenches must be properly shored and braced as required by applicable federal and state OSHA codes, and as necessary to protect life and property.

CONSTRUCTION CONSIDERATIONS

Groundwater Control

Groundwater observations were made during the drilling operations, and in the open boreholes at completion. Groundwater was encountered during auger advancement in borings B-1, B-2, and B-6 through B-10 at depths of about 22 to 23.5 feet (EL. 617 to EL. 614.5) below existing grade. All of the holes caved to varying depths upon withdrawal of the auger; therefore, observations could not be made below the caved depth.

Based on the observations, and the estimated floor elevation (EL. 638.5), no major difficulties during excavation and construction of the proposed shallow foundation system and associated shallow utilities is anticipated. A gravity drainage system and filtered sump pumps or other conventional dewatering procedures, may be adequate to control low volume perched water. However, for rising groundwater levels, or for large volume perched zones (and dependent upon the depth of the stormwater basins), prolonged dewatering with a series of sump pumps with sufficient lifting capacity may be necessary to facilitate construction.

Seasonal variations in precipitation, site drainage conditions, soil permeability, and other factors can cause groundwater levels to rise and/or perched zones to be present in the upper soils at varying times of the year, including during construction.

Excavations and Site Drainage

Sloping, shoring or bracing of the excavation sidewalls will be necessary to facilitate construction and to protect life and property. Sloughing and caving should be expected within unprotected excavations. The degree of excavation instability problems is dependent upon the depth and length of time that excavations remain open, excavation bank slopes, water levels and the effectiveness of any dewatering systems. However, severe instability may occur within granular or soft clay soils, especially encroaching upon and extending below the groundwater

or perched zones. All excavation work must be performed in accordance with OSHA and local building code requirements.

Where excavations encroach upon or extend below the groundwater or perched zones and into granular or soft clay soils, a substantially unstable subgrade may develop when the confining effect of the overburden is removed. Significant sloughing or caving of sidewalls may also occur. Some overexcavation of softened or loosened soils, in conjunction with the use of a crushed stone working mat, may be necessary to establish a stable bearing subgrade. Additionally, significantly widened excavations may result, or be required to maintain or achieve sidewall stability.

All excavations must be performed with caution and utilize methods which will prevent undermining or destabilization of buildings, utilities, pavements, or other structures. The use of a properly designed shoring and bracing, sheet piling, or underpinning system must be utilized as necessary to adequately protect utilities, pavements, and other structures. This must be performed by an experienced specialty contractor. Additionally, extreme care must be used during the installation of any bracing system, especially those using driven or vibratory methods, in order to avoid damaging existing buildings, utilities, and other structures. Consideration should be given to the performance of video and/or photographic documentation of the condition of nearby buildings, utilities, and other structures prior to installation.

It is mandated that excavations, whether they be for utility trenches, basement excavations or footing excavations, be constructed in accordance with current Occupational Safety and Health Administration (OSHA) guidelines to protect workers and others during construction. PSI recommends that these regulations be strictly enforced. The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's "responsible person", as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations. PSI is providing this information solely as a service to our client. PSI does not assume responsibility for construction site safety or the contractor's or other parties' compliance with local, state, and federal safety or other regulations.

Since the subgrade soils are generally sensitive to moisture, every effort should be made to provide adequate drainage across the site during construction, and to prevent ponding of runoff on the subgrade. These soils are also subject to erosion caused by runoff, and erosion control measures should be implemented where needed or required by local ordinances.

Seismic Design Considerations

The soils encountered in the borings are estimated to meet the criteria for Site Class D in accordance with 1613.2.5.2 of the International Building Code-2018 (which directs to the

simplified design procedure outlined in ASCE 7 – Minimum Design Loads and Associated Criteria for Buildings and Other Structures).

PAVEMENT DESIGN RECOMMENDATIONS

Pavements for this project are understood to consist of asphalt and/or concrete parking lots and driveways, and concrete loading docks. Traffic loads were not provided for the purpose of this report. We assume the light-duty and heavy duty traffic loading will not exceed 40,000 18-kip ESAL's (up to 8 light delivery trucks per day) and 80,000 18- kip ESAL's (based on up to 8 light delivery trucks, 2 medium trucks and 1 heavy delivery truck per day) respectively for a 20-year design life. When the actual project traffic loads are determined, they must be provided to PSI so that any revision to the pavement section and recommendations provided herein can be made.

The pavement subgrade soils encountered in the borings generally consisted of sand, with an estimated visual AASHTO classification of A-2-4. They are generally rated as fair for pavement subgrade support due to their moderate frost susceptibility, fair drainage characteristics, and lower susceptibility to strength loss when exposed to free water. Based on the A-2-4 soil classification an estimated Resilient Modulus, Mr of 4000 psi and Modulus of Subgrade Reaction, K of 200 was used for this evaluation. In order to use these values, all new fill used to raise low areas must have pavement support characteristics that are equal to or better than the granular soils.

During construction, the surficial subgrade soils can become wet, softened and disturbed from rainfall and construction equipment. Therefore, prior to placing the pavement base materials, the subgrade must be proofrolled as outlined previously. Particular attention should be given to high traffic areas that have become rutted and areas of backfilled trenches. Localized wet, soft, or unstable areas can be undercut to such depths determined necessary in the field to reach stable materials, and the area backfilled with crushed stone, such as 1¼-inch dense graded base (Section 305 of the State of Wisconsin Standard Specification for Highway and Structure Construction). If relatively large or thick zones of extensive yielding are observed, and normal discing and recompaction procedures cannot stabilize them, undercutting and replacement with crushed stone and geotextile fabric may be required in these areas. Preparation and evaluation of the pavement subgrade must be performed as outlined in the Site Preparation section of this report.

The recommended minimum pavement section was determined utilizing the WinPAS pavement design software. This program embodies the methodology of the 1993 AASHTO Guide for the Design of Pavement Structures. The following design factors were used in developing the recommended pavement sections.

- Design Life: 20 years
- Design Traffic (Heavy Duty): 110,000 ESALs (rigid); 80,000 ESALs (flexible)
- Design Traffic (Light Duty): 40000 ESALs
- Soils Resilient Modulus, Mr: 4000
- Modulus of Subgrade Reaction, k: 175 pci
- Reliability: 85%
- Initial Serviceability: 4.5 (rigid); 4.2 (flexible)
- Terminal Serviceability: 2.0
- Standard Deviation: 0.35 (rigid), 0.45 (flexible)
- Load Transfer Coefficient J: 3.2
- Concrete Modulus of Rupture: 600 psi
- Structural Coefficient Hot Mix Asphalt: 0.44
- Structural Coefficient Aggregate Base: 0.14

The following table presents the recommended thickness for a flexible pavement structure on a properly prepared clay subgrade, along with their recommended structural coefficients.

PAVEMENT COMPONENTS	HEAVY DUTY AREAS	STANDARD DUTY AREAS	WISCONSIN DOT SPECIFICATIONS
Asphaltic Concrete Surface Course	1.5”	1.75”	Section 460 (a=0.44)
Asphaltic Concrete Binder Course	2.0”	2.25”	Section 460 (a=0.44)
Aggregate Base Course	9”	9”	Section 305 1¼” Crushed Stone (a=0.14)

The asphaltic base and surface course should be placed and provided in accordance with Section 455/460 of the State of Wisconsin Standard Specification for Highway and Structure Construction. The crushed aggregate base course should be provided and placed in accordance with Section 301/305 of the Standard Specification.

It may be advantageous to utilize rigid Portland Cement Concrete pavement at entrance and exit aprons. It is recommended that a minimum of 6 inches of 4,000 psi, air-entrained concrete (5 to 7 percent) be utilized along with a 6-inch thickness of aggregate base for a rigid pavement section. The construction materials and procedures should be in accordance with Section 415 and Section 305 (for concrete and base course, respectively) of the WisDOT Standard Specification.

The thickness designs shown above are based on an estimated traffic loading by PSI; the assumption that all subgrade materials, natural or fill, have minimum strength characteristics equal to or greater than the expected clay soils; the subgrade being properly prepared; and the pavement being properly drained to prevent softening and erosion of the subgrade. Actual

service life will be dependent upon deterioration caused by weather conditions and pavement use. All pavement materials and construction must be in accordance with the guidelines of the State of Wisconsin Standard Specification for Highway and Structure construction. If design traffic loading is found to be different from that discussed above; or if the soils encountered at planned subgrade vary from the anticipated clay fill soils; new pavement section designs may be necessary.

It should be recognized that all pavements require regular maintenance and occasional repairs to keep the pavements in a serviceable condition. Maintenance is necessary to reduce the effects of pavement stress caused by changes in temperature and moisture, repetitive traffic loadings, and movement of the subgrade soils. As pavement distress is observed, it should be repaired as quickly as possible. Timely sealing of joints and cracks is essential to help reduce the potential for water to enter the pavement section and cause rapid deterioration of the pavement during freeze-thaw cycles. Unrepaired areas will generally lead to more severe and widespread distress, and eventually, pavement disintegration. Therefore, annual maintenance should include sealing of cracks and joints, and maintenance of proper surface drainage to avoid ponding water on or near the pavements. Periodic pavement condition surveys of the pavement can also be implemented to evaluate the need for other surface maintenance, and treatments or repairs that may be needed to obtain the design service life.

The subject site is located in an area that experiences annual freezing cycles. The granular subgrade soils encountered at the borings are not generally considered to be highly susceptible to frost action. However, near surface layers of finer grained soils may be encountered. In addition, it is generally good customary practice to control surface runoff in order to reduce the potential for frost action. It is recommended that underdrains be placed within the subgrade, just below the granular base, to help reduce the potential for trapping water within the aggregate base layer. Sufficient drain tiles extending radially outward an adequate distance from each interior catch basin must be installed. In addition, drain tiles should extend along curb lines, up the slope from curb inlets. The drain tile should be directly connected to the storm sewer manholes or catch basins (if permissible by local municipal or other applicable code). The drain tile should consist of perforated PVC pipe of adequate diameter placed beneath the base layer, extending a sufficient distance into the subgrade. The pipe should be surrounded by appropriately sized clean stone, with the pipe and stone being wrapped with a geotextile filter fabric to reduce the potential for soils to migrating into and obstruct the pipe. It is also recommended that roof drains be connected to the stormwater collection system to minimize the potential for this water to enter the base and subgrade.

STORMWATER MANAGEMENT AREA CONSIDERATIONS

As requested by the client, borings B-1 and B-2 were performed in the area of the proposed stormwater management. The subgrade soils encountered at these locations have been visually classified in general accordance with the USDA textural soil classification system The

materials extending from the surface at B-1 consisted of gravelly loamy sand, sand, very and gravelly medium sand classified as fill to a depth of about 11.5 feet (EL. 626.5). The materials extending from the surface at B-2 consisted of silty clay loam and sandy loam classified as fill to a depth of about 12.5 feet (EL. 624.5). The underlying soils consisted of medium sand, fine to medium sand, sandy loam, and gravelly sandy loam to the termination depths. Groundwater was encountered at a depth of about 22 feet (EL. 616 and EL. 619).

With regard to the above soil and groundwater conditions encountered at the borings, NR 151.124(4)(c)1 and 2 – *Infiltration rate exemptions* indicates that infiltration practices located in an area where the infiltration rate of the soil measured at the proposed bottom of the infiltration system is less than 0.6 inches per hour using a scientifically credible field test method; or an area where the least permeable soil horizon to 5 feet below the proposed bottom of the infiltration system using the USDA method of soils analysis consists of sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay or clay may be credited toward meeting the requirements, but the decision to infiltrate under these conditions is optional. In addition, NR 151.124(4)(b)1 – *Separation distances* indicates that infiltration practices shall be located so that the characteristics of the soil and the separation distance between the bottom of the infiltration system and the elevation of seasonal high groundwater or the top of bedrock are in accordance with the following Table (reproduced from NR 151.124):

TABLE 3. SEPARATION DISTANCES AND SOIL CHARACTERISTICS

SOURCE AREA	SEPARATION DISTANCE	SOIL CHARACTERISTICS
Industrial, Commercial, Institutional Parking Lots and Roads	5 feet or more	Filtering Layer*
Residential Arterial Roads	5 feet or more	Filtering Layer*
Roofs Draining to Surface Infiltration Practices	1 foot or more	Native or Engineered Soil with Particles Finer than Coarse Sand
Roofs Draining to Surface Infiltration Practices	Not Applicable	
All Other Impervious Source Areas	3 feet or more	Filtering Layer*

*Defined in NR 151.002(14r) as a "soil that has at least a 3-foot deep layer with at least 20 percent fines; or at least a 5-foot deep layer with at least 10 percent fines; or an engineered soil with an equivalent level of protection as determined by the regulatory authority for the site."

The information shown above is a selected excerpt from NR151 that is intended only as general guidance for considering stormwater management in conjunction with the encountered subsurface conditions at the borings. Basin design must be performed by a qualified and experienced firm. In addition, the entirety of Chapter NR151 of the Wisconsin Administrative Code, the Site Evaluation for Stormwater Infiltration (1002) document, and other applicable

references; along with appropriate state, local or other municipal requirements must be consulted as part of site specific stormwater design.

It is recommended that stormwater management basins not be placed in close proximity to basements or other below grade structures. Proper and careful consideration of soils and subsurface conditions must be given during site and design planning, and extreme care must be exercised during construction. Lateral migration of water may result in substantially increased sump pump activity and can quickly overcome the ability of such pumps to maintain a desirable water level, resulting in significant flooding. The potential for such conditions to occur can greatly increase when below grade floor elevations encroach upon or are below the elevation of basin bottoms and/or when basins are placed in close proximity to structures (strongly not recommended). In addition, the presence of granular or other generally permeable soils, which is typically necessary in the areas of structures for utility backfill, alongside basement walls, or within other development excavations/trenches can act as extensive migration channels to rapidly carry large volumes of water from basins and into nearby below grade structures. Building codes or municipal regulations may require that floor elevations of below grade structures be a specified distance above the water level of nearby basins or other stormwater features. It is therefore recommended that the design engineer (or other appropriate representative) review applicable municipal or other regulatory requirements and verify the design normal and design high water elevations of stormwater basins/features with respect to planned or existing below grade slab elevations.

GENERAL COMMENTS

This geotechnical exploration and evaluation has been prepared to aid in the evaluation of the subsurface conditions on this site. The recommendations presented herein are based on the available soil information and the preliminary project information provided. Any changes in the planned project activities should be brought to the attention of the soil engineer to determine if modifications in the recommendations are required. The final design plans and specifications should also be reviewed by the soil engineer to determine that the recommendations presented herein have been interpreted and implemented as intended.

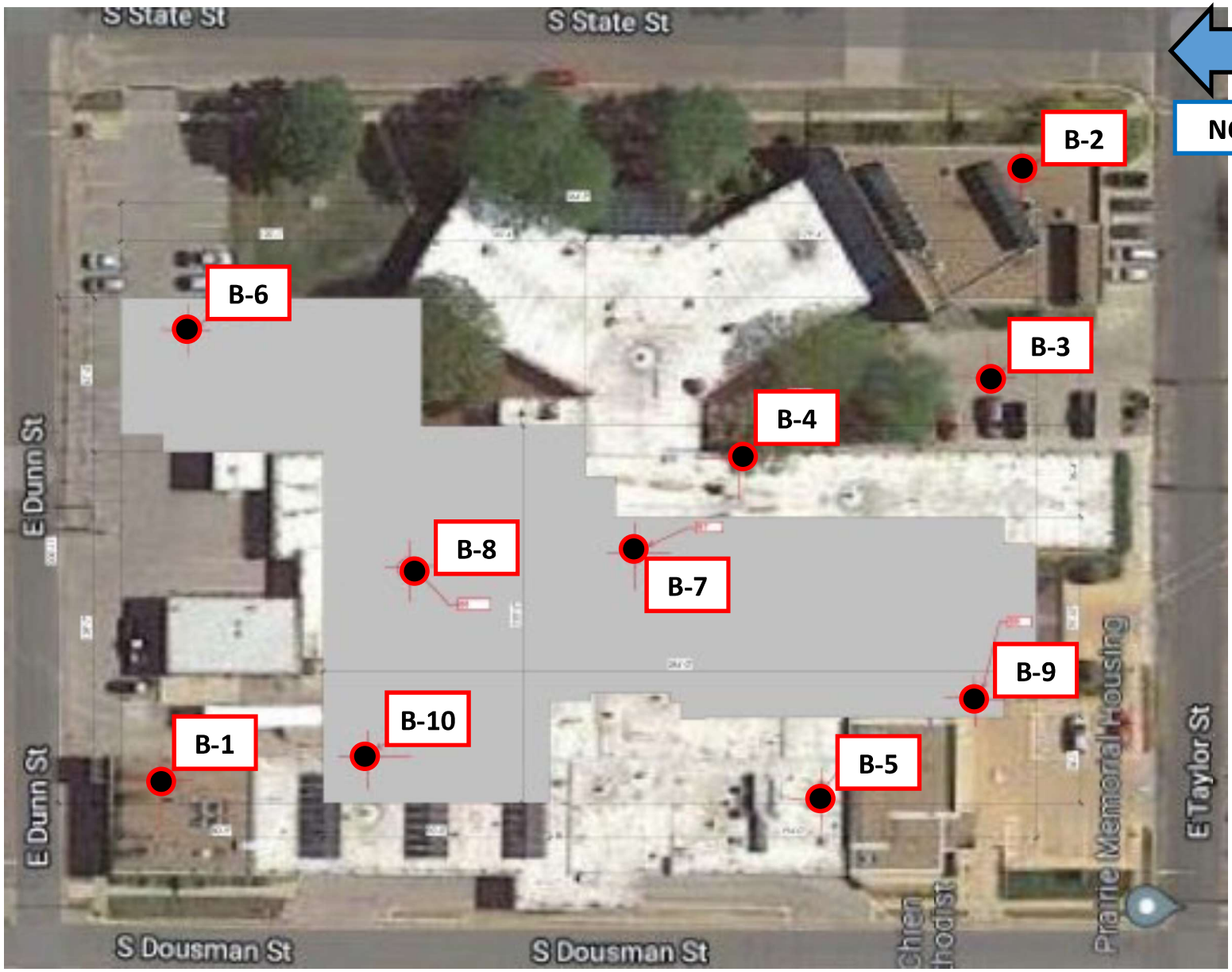
This geotechnical study has been conducted in a manner consistent with that level of care ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. The findings, recommendations and opinions contained herein have been promulgated in accordance with generally accepted practice in the fields of foundation engineering, soils mechanics, and engineering geology. No other representations, expressed or implied, and no warranty or guarantee is included or intended in this report.

It is recommended that the earthwork and foundation operations be monitored by the soil engineer, to test and evaluate the subgrade stability, bearing capacities, and the selection, placement and compaction of controlled fills. WisDOT Standard Specifications for Highway and

Structure Construction can also serve as a guide in implementing the subgrade preparation and other earthwork operations.

Appendix

Figure 1 – Boring Location Plan
Soil Boring Logs
General Notes
Soil Evaluation – Storm Form
USDA Classification Chart



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Prairie du Chien PSC Facility
NEC of S. Dousman St. and E. Taylor St.
Prairie du Chien, WI

SCALE: 1 inch = 60 feet (approx.)

DATE: 04/30/2024

FIGURE 1: BORING LOCATION PLAN

PROJECT NUMBER: 00523381

BORING B-1

DATE STARTED:	4/15/24	**DRILL COMPANY:**	Groundbreaking Exploration
DATE COMPLETED:	4/15/24	**DRILLER:** Jonathan	**LOGGED BY:** Wilber
COMPLETION DEPTH	27.0 ft	**DRILL RIG:**	ATV
BENCHMARK:	N/A	**DRILLING METHOD:**	Hollow Stem Auger
ELEVATION:	638 ft	**SAMPLING METHOD:**	2-in SS
LATITUDE:		**HAMMER TYPE:**	Automatic
LONGITUDE:		**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	

REMARKS:

Water

While Drilling	22 feet
Upon Completion	Not Obsvd
Delay	N/A

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %
	0			1	24	Fill, Very Dark Brown Gravelly Loamy Sand, Moist		4-5-3-4 N=8	10
635				2	10			2-2-1-2 N=3	8
	5			3	10	Fill, Dark Brown Sand, Moist		2-1-1-2 N=2	7
				4	10			2-3-3-3 N=6	
630				5	7	Fill, Light Brownish Gray Very Gravelly Medium Sand, Moist to Very Moist		12-8-11-14 N=19	7
	10			6	20			9-10-14-17 N=24	14
				7	18	Dark Brown Medium Sand, Moist		3-3-5-6 N=8	2
625	15			8	24			3-3-3-5 N=6	2
				9	18			2-3-3-4 N=6	3
620				10	24	Brown Fine to Medium Sand, Moist to Wet		3-3-4-6 N=7	3
	20			11	18			5-4-4-7 N=8	3
615				12	16			3-3-3-4 N=6	22
	25			13	16			3-2-0-0 N=2	24
				14	12			2-5-10-6 N=15	18
						End of Boring at 27'			
						Cave-In at 10'			

STANDARD PENETRATION TEST DATA
N in blows/ft ◎
× Moisture ◪ PL ✚ LL
0 25 50
STRENGTH, tsf
▲ Qu ✳ Qp
0 2.0 4.0

Additional Remarks

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PROJECT NO.: 00523381
PROJECT: Proposed Prairie du Chien Public Safety Bldg
LOCATION: NEC of E. Taylor St. & S. Dousman St.
Prairie du Chien, WI

The stratification lines represent approximate boundaries. The transition may be gradual.

BORING B-2

DATE STARTED:	4/16/24	**DRILL COMPANY:**	Groundbreaking Exploration
DATE COMPLETED:	4/16/24	**DRILLER:** Jonathan	**LOGGED BY:** Wilber
COMPLETION DEPTH	25.0 ft	**DRILL RIG:**	ATV
BENCHMARK:	N/A	**DRILLING METHOD:**	Hollow Stem Auger
ELEVATION:	639 ft	**SAMPLING METHOD:**	2-in SS
LATITUDE:		**HAMMER TYPE:**	Automatic
LONGITUDE:		**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	

REMARKS:

Water

While Drilling	22 feet
Upon Completion	Not Obsvd
Delay	N/A

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0 25 50) STRENGTH, tsf ▲ Qu ✳ Qp (0 2.0 4.0)	Additional Remarks
	0			1	24	Fill, Black Silty Clay Loam, Moist		2-3-4-4 N=7	9		
				2	10	Fill, Very Dark Brown Silty Clay Loam, Moist		3-3-3-4 N=6	13		
635				3	18	Fill, Very Dark Grayish Brown Silty Clay Loam, Moist		4-5-8-12 N=13	13		Q_r = 1.1 tsf
	5			4	10	Fill, Brown Sandy Loam, Moist		50/3"	7	>>	
630				5	10			62/8"	6	>>	
	10			6	6			50/5"	5	>>	
				7	0	Dark Brown Gravelly Sandy Loam, Moist		50/1"	6 7	>>	
625				8	15			9-9-11-16 N=20	3		
	15			9	16	Brown Gravelly Sandy Loam, Moist to Wet		3-6-5-5 N=11	3		
620				10	24			3-3-4-6 N=7	12		
	20			11	18			2-3-3-4 N=6	4		
				12	16			3-4-3-4 N=7	15		
615				13	18			2-3-4-4 N=7	26		
	25					End of Boring at 25' Cave-In at 10'					

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The stratification lines represent approximate boundaries. The transition may be gradual.

BORING B-3

DATE STARTED:	4/16/24	**DRILL COMPANY:**	Groundbreaking Exploration
DATE COMPLETED:	4/16/24	**DRILLER:** Jonathan	**LOGGED BY:** Wilber
COMPLETION DEPTH	15.0 ft	**DRILL RIG:**	ATV
BENCHMARK:	N/A	**DRILLING METHOD:**	Hollow Stem Auger
ELEVATION:	639 ft	**SAMPLING METHOD:**	2-in SS
LATITUDE:		**HAMMER TYPE:**	Automatic
LONGITUDE:		**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	

REMARKS:

Water		
	While Drilling	Not Obsvd
	Upon Completion	Not Obsvd
	Delay	N/A

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0 25 50) STRENGTH, tsf ▲ Qu ✳ Qp (0 2.0 4.0)	Additional Remarks
	0					Topsoil, Dark Brown Silt, Fine Sand, Moist (10"± Thick)	TPSL		6	×	
				1	16	Brown Medium to Coarse Sand and Gravel, Moist	SP	3-4-4 N=8	3	× ◎	
635				2	18	Brown Fine to Medium Sand, Trace Gravel, Moist	SP	2-3-4 N=7	5	× ◎	
	5			3	18	Brown Fine to Coarse Sand, Trace to With Gravel, Moist		3-3-3 N=6	4	× ◎	
630				4	18			3-3-5 N=8	4	× ◎	
	10						SP				
625				5	18			3-4-4 N=8	3	× ◎	
	15					End of Boring at 15' Cave-In at 9'					

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BORING B-4

DATE STARTED:	4/15/24	**DRILL COMPANY:**	Groundbreaking Exploration
DATE COMPLETED:	4/15/24	**DRILLER:** Jonathan	**LOGGED BY:** Wilber
COMPLETION DEPTH	15.0 ft	**DRILL RIG:**	ATV
BENCHMARK:	N/A	**DRILLING METHOD:**	Hollow Stem Auger
ELEVATION:	639 ft	**SAMPLING METHOD:**	2-in SS
LATITUDE:		**HAMMER TYPE:**	Automatic
LONGITUDE:		**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	

REMARKS:

Water		
	While Drilling	Not Obsvd
	Upon Completion	Not Obsvd
	Delay	N/A

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0, 25, 50) STRENGTH, tsf ▲ Qu ✳ Qp (0, 2.0, 4.0)	Additional Remarks
	0					Topsoil Fill, Dark Brown Silty Stone Sand, Moist (12"± Thick)	TPSL FILL		7	×	
				1	16	Fill, Brown Fine to Medium Sand and Gravel, Possible Concrete and Brick Fragments, Moist	FILL	3-3-4 N=7	5	× ◎	
635				2	6	Brown Medium Sand, With to Trace Gravel, Moist to Very Moist		2-3-4 N=7	6	× ◎	
	5			3	18			3-4-4 N=8	5	× ◎	
630				4	18		SP	4-4-4 N=8	2	× ◎	
	10										
625				5	16			4-4-4 N=8	3	× ◎	
	15					End of Boring at 15'					
						Cave-In at 9'					

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BORING B-5

DATE STARTED:	4/16/24	**DRILL COMPANY:**	Groundbreaking Exploration
DATE COMPLETED:	4/16/24	**DRILLER:** Jonathan	**LOGGED BY:** Wilber
COMPLETION DEPTH	15.0 ft	**DRILL RIG:**	ATV
BENCHMARK:	N/A	**DRILLING METHOD:**	Hollow Stem Auger
ELEVATION:	638 ft	**SAMPLING METHOD:**	2-in SS
LATITUDE:		**HAMMER TYPE:**	Automatic
LONGITUDE:		**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	

REMARKS:

Water		
	While Drilling	Not Obsvd
	Upon Completion	Not Obsvd
	Delay	N/A

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0, 25, 50) STRENGTH, tsf ▲ Qu ✳ Qp (0, 2.0, 4.0)	Additional Remarks
	0					Topsoil Fill, Dark Brown Silty Fine Sand, Moist (12"± Thick)	TPSL FILL		6	×	
				1	18	Fill, Dark Brown Sand and Gravel, Trace Silt, Moist	FILL	3-5-6 N=11	12	◎	
635						Brown Fine to Medium Sand, Trace Gravel, Moist					
				2	18			3-6-6 N=12	5	× ◎	
	5										
				3	18		SP	3-3-3 N=6	4	× ◎	
630											
				4	12			3-3-8 N=11	4	× ◎	
	10										
						Brown Fine to Coarse Sand, Possible Gravel, Very Moist					
625							SP				
				5	18			3-3-3 N=6	5	× ◎	
	15					End of Boring at 15'					
						Cave-In at 9'					

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Prairie du Chien, WI

The stratification lines represent approximate boundaries. The transition may be gradual.

BORING B-6

DATE STARTED:	4/16/24	**DRILL COMPANY:**	Groundbreaking Exploration
DATE COMPLETED:	4/16/24	**DRILLER:** Jonathan	**LOGGED BY:** Wilber
COMPLETION DEPTH	30.0 ft	**DRILL RIG:**	ATV
BENCHMARK:	N/A	**DRILLING METHOD:**	Hollow Stem Auger
ELEVATION:	639 ft	**SAMPLING METHOD:**	2-in SS
LATITUDE:		**HAMMER TYPE:**	Automatic
LONGITUDE:		**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	

REMARKS:

Water

While Drilling	23.5 feet
Upon Completion	Not Obsvd
Delay	N/A

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0 25 50) STRENGTH, tsf ▲ Qu ✳ Qp (0 2.0 4.0)	Additional Remarks
	0					Fill, Brown Sand and Gravel, Possible Brick Fragments, Moist (36"± Thick)	FILL				
				1	18			5-6-8 N=14	5		
635						Brown Fine to Medium Sand, Trace to With Gravel, Moist					
	5			2	18			3-4-8 N=12	6		
				3	18			3-4-4 N=8	3		
630											
	10			4	18		SP	3-3-4 N=7	3		
625											
	15			5	18			3-4-4 N=8	4		
						Brown Fine to Medium Sand, Trace Clay, Moist					
620											
	20			6	18		SP	3-4-5 N=9	3		
						Brown Fine to Coarse Sand, Trace Gravel, Moist to Wet					
615											
	25			7	18		SP	2-2-3 N=5	6		
610											
	30			8	18			4-5-7 N=12	21		
						End of Boring at 30'					
						Cave-In at 15'					

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BORING B-7

DATE STARTED:	4/15/24	**DRILL COMPANY:**	Groundbreaking Exploration
DATE COMPLETED:	4/15/24	**DRILLER:** Jonathan	**LOGGED BY:** Wilber
COMPLETION DEPTH	25.0 ft	**DRILL RIG:**	ATV
BENCHMARK:	N/A	**DRILLING METHOD:**	Hollow Stem Auger
ELEVATION:	638.5 ft	**SAMPLING METHOD:**	2-in SS
LATITUDE:		**HAMMER TYPE:**	Automatic
LONGITUDE:		**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	

REMARKS:

Water

While Drilling	23.5 feet
Upon Completion	Not Obsvd
Delay	N/A

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0 25 50) STRENGTH, tsf ▲ Qu ✳ Qp (0 2.0 4.0)	Additional Remarks
	0					Topsoil Fill, Dark Brown Fine to Medium Sand, Moist (10"± Thick)	TPSL FILL		10		
				1	10	Fill, Dark Brown Sand and Gravel, With Possible Brick Fragments, Moist	FILL	5-7-7 N=14	13		
635						Brown Fine to Coarse Sand, With to Trace Gravel, Moist to Wet					
	5			2	18			3-5-5 N=10	3		
				3	18			4-4-5 N=9	3		
630											
				4	16			3-4-4 N=8	2		
	10										
625											
				5	18		SP	2-3-4 N=7	3		
	15										
620											
				6	16			3-3-3 N=6	2		
	20										
615											
				7	18			4-5-5 N=10	19		
	25					End of Boring at 25'					
						Cave-In at 9'					

intertek psi

Professional Service Industries, Inc.
821 Corporate Court, Suite 100
Waukesha, WI 53189
Telephone: (262) 521-2125

PROJECT NO.: 00523381
PROJECT: Proposed Prairie du Chien Public Safety Bldg
LOCATION: NEC of E. Taylor St. & S. Dousman St.
Prairie du Chien, WI

The stratification lines represent approximate boundaries. The transition may be gradual.

BORING B-8

DATE STARTED:	4/15/24	**DRILL COMPANY:**	Groundbreaking Exploration
DATE COMPLETED:	4/15/24	**DRILLER:** Jonathan	**LOGGED BY:** Wilber
COMPLETION DEPTH	25.0 ft	**DRILL RIG:**	ATV
BENCHMARK:	N/A	**DRILLING METHOD:**	Hollow Stem Auger
ELEVATION:	639 ft	**SAMPLING METHOD:**	2-in SS
LATITUDE:		**HAMMER TYPE:**	Automatic
LONGITUDE:		**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	

REMARKS:

Water

While Drilling	23.5 feet
Upon Completion	Not Obsvd
Delay	N/A

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ Moisture PL LL (0 25 50) STRENGTH, tsf Qu Qp (0 2.0 4.0)	Additional Remarks
	0					Topsoil Fill, Dark Brown Silty Fine Sand, Moist (12"± Thick)	TPSL FILL		7		
				1	12	Fill, Dark Brown Silty Fine to Coarse Sand and Trace Gravel, Possible Brick Fragments, Moist	FILL	3-2-1 N=3	6		
635				2	18	Brown Fine to Coarse Sand, Trace to With Gravel, Moist to Wet		3-3-4 N=7	4		
	5			3	18			3-4-4 N=8	6		
630				4	18			4-4-5 N=9	2		
	10										
625				5	18		SP	4-6-6 N=12	3		
	15										
620				6	18			3-4-5 N=9	3		
	20										
615				7	18			3-5-5 N=10	22		
	25					End of Boring at 25' Cave-In at 10'					

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PROJECT: Proposed Prairie du Chien Public Safety Bldg
LOCATION: NEC of E. Taylor St. & S. Dousman St.
Prairie du Chien, WI

The stratification lines represent approximate boundaries. The transition may be gradual.

BORING B-9

DATE STARTED:	4/16/24	**DRILL COMPANY:**	Groundbreaking Exploration
DATE COMPLETED:	4/16/24	**DRILLER:** Jonathan	**LOGGED BY:** Wilber
COMPLETION DEPTH	25.0 ft	**DRILL RIG:**	ATV
BENCHMARK:	N/A	**DRILLING METHOD:**	Hollow Stem Auger
ELEVATION:	638 ft	**SAMPLING METHOD:**	2-in SS
LATITUDE:		**HAMMER TYPE:**	Automatic
LONGITUDE:		**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	

REMARKS:

Water

While Drilling	23.5 feet
Upon Completion	Not Obsvd
Delay	N/A

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0, 25, 50) STRENGTH, tsf ▲ Qu ✳ Qp (0, 2.0, 4.0)	Additional Remarks
	0					Topsoil, Dark Brown Silty Fine Sand, Moist (5"± Thick)	TPSL				
635				1	18	Brown Fine to Coarse Sand, Trace to With Gravel, Moist		3-4-6 N=10	4		
	5			2	18			2-3-5 N=8	4		
				3	18			2-3-3 N=6	5		
630				4	18			3-3-4 N=7	3		
	10										
625							SP				
				5	18			3-3-4 N=7	3		
	15										
620				6	18			3-4-6 N=10	3		
	20										
615				7	18			3-5-6 N=11	19		
	25					End of Boring at 25'					
						Cave-In at 10'					

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PROJECT NO.: 00523381
PROJECT: Proposed Prairie du Chien Public Safety Bldg
LOCATION: NEC of E. Taylor St. & S. Dousman St.
Prairie du Chien, WI

The stratification lines represent approximate boundaries. The transition may be gradual.

BORING B-10

DATE STARTED:	4/15/24	**DRILL COMPANY:**	Groundbreaking Exploration
DATE COMPLETED:	4/15/24	**DRILLER:** Jonathan	**LOGGED BY:** Wilber
COMPLETION DEPTH	25.0 ft	**DRILL RIG:**	ATV
BENCHMARK:	N/A	**DRILLING METHOD:**	Hollow Stem Auger
ELEVATION:	638 ft	**SAMPLING METHOD:**	2-in SS
LATITUDE:		**HAMMER TYPE:**	Automatic
LONGITUDE:		**EFFICIENCY**	N/A
STATION: N/A	**OFFSET:** N/A	**REVIEWED BY:**	

REMARKS:

Water

While Drilling	23.5 feet
Upon Completion	Not Obsvd
Delay	N/A

BORING LOCATION:

Elevation (feet)	Depth, (feet)	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %
	0			Topsoil Fill, Dark Brown Silty Fine to Medium Sand (5"± Thick)	TPSL FILL		7
		1	16	Fill, Dark Brown Silty Fine to Coarse Sand and Gravel, Brick and Wood Fragments, Very Moist	FILL	3-3-3 N=6	11
635							
		2	18	Brown Fine to Coarse Sand, Trace Gravel, Moist to Wet		3-4-6 N=10	4
	5						
		3	18			2-3-3 N=6	5
630							
		4	18			3-4-7 N=11	5
	10						
625							
		5	18		SP	3-3-4 N=7	3
	15						
620							
		6	18			3-3-4 N=7	2
	20						
615							
		7	18			4-4-5 N=9	18
	25			End of Boring at 25'			
				Cave-In at 7'			

STANDARD PENETRATION TEST DATA
N in blows/ft ◎
× Moisture ◪ PL ✚ LL
0 25 50
STRENGTH, tsf
▲ Qu ✳ Qp
0 2.0 4.0

Additional Remarks

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Prairie du Chien, WI

The stratification lines represent approximate boundaries. The transition may be gradual.

GENERAL NOTES

SAMPLE IDENTIFICATION

The Unified Soil Classification System (USCS), AASHTO 1988 and ASTM designations D2487 and D-2488 are used to identify the encountered materials unless otherwise noted. Coarse-grained soils are defined as having more than 50% of their dry weight retained on a #200 sieve (0.075mm); they are described as: boulders, cobbles, gravel or sand. Fine-grained soils have less than 50% of their dry weight retained on a #200 sieve; they are defined as silts or clay depending on their Atterberg Limit attributes. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size.

DRILLING AND SAMPLING SYMBOLS

SFA: Solid Flight Auger - typically 4" diameter flights, except where noted.
HSA: Hollow Stem Auger - typically 3¼" or 4¼ I.D. openings, except where noted.
M.R.: Mud Rotary - Uses a rotary head with Bentonite or Polymer Slurry
R.C.: Diamond Bit Core Sampler
H.A.: Hand Auger
P.A.: Power Auger - Handheld motorized auger

SS: Split-Spoon - 1 3/8" I.D., 2" O.D., except where noted.
ST: Shelby Tube - 3" O.D., except where noted.
RC: Rock Core
TC: Texas Cone
BS: Bulk Sample
PM: Pressuremeter
CPT-U: Cone Penetrometer Testing with Pore-Pressure Readings

SOIL PROPERTY SYMBOLS

N: Standard "N" penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2-inch O.D. Split-Spoon.
N_{60}: A "N" penetration value corrected to an equivalent 60% hammer energy transfer efficiency (ETR)
Q_u: Unconfined compressive strength, TSF
Q_p: Pocket penetrometer value, unconfined compressive strength, TSF
w%: Moisture/water content, %
LL: Liquid Limit, %
PL: Plastic Limit, %
PI: Plasticity Index = (LL-PL),%
DD: Dry unit weight, pcf
▼,▽,▼ Apparent groundwater level at time noted

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Relative Density	N - Blows/foot
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	50 - 80
Extremely Dense	80+

ANGULARITY OF COARSE-GRAINED PARTICLES

Description	Criteria
Angular:	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular:	Particles are similar to angular description, but have rounded edges
Subrounded:	Particles have nearly plane sides, but have well-rounded corners and edges
Rounded:	Particles have smoothly curved sides and no edges

GRAIN-SIZE TERMINOLOGY

Component	Size Range
Boulders:	Over 300 mm (>12 in.)
Cobbles:	75 mm to 300 mm (3 in. to 12 in.)
Coarse-Grained Gravel:	19 mm to 75 mm (¾ in. to 3 in.)
Fine-Grained Gravel:	4.75 mm to 19 mm (No.4 to ¾ in.)
Coarse-Grained Sand:	2 mm to 4.75 mm (No.10 to No.4)
Medium-Grained Sand:	0.42 mm to 2 mm (No.40 to No.10)
Fine-Grained Sand:	0.075 mm to 0.42 mm (No. 200 to No.40)
Silt:	0.005 mm to 0.075 mm
Clay:	<0.005 mm

PARTICLE SHAPE

Description	Criteria
Flat:	Particles with width/thickness ratio > 3
Elongated:	Particles with length/width ratio > 3
Flat & Elongated:	Particles meet criteria for both flat and elongated

RELATIVE PROPORTIONS OF FINES

Descriptive Term	% Dry Weight
Trace:	< 5%
With:	5% to 12%
Modifier:	>12%

GENERAL NOTES

(Continued)

CONSISTENCY OF FINE-GRAINED SOILS

Q_U - TSF	N - Blows/foot	Consistency
0 - 0.25	0 - 2	Very Soft
0.25 - 0.50	2 - 4	Soft
0.50 - 1.00	4 - 8	Firm (Medium Stiff)
1.00 - 2.00	8 - 15	Stiff
2.00 - 4.00	15 - 30	Very Stiff
4.00 - 8.00	30 - 50	Hard
8.00+	50+	Very Hard

MOISTURE CONDITION DESCRIPTION

Description	Criteria
Dry:	Absence of moisture, dusty, dry to the touch
Moist:	Damp but no visible water
Wet:	Visible free water, usually soil is below water table

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term	% Dry Weight
Trace:	< 15%
With:	15% to 30%
Modifier:	>30%

STRUCTURE DESCRIPTION

Description	Criteria
Stratified:	Alternating layers of varying material or color with layers at least ¼-inch (6 mm) thick
Laminated:	Alternating layers of varying material or color with layers less than ¼-inch (6 mm) thick
Fissured:	Breaks along definite planes of fracture with little resistance to fracturing
Slickensided:	Fracture planes appear polished or glossy, sometimes striated
Blocky:	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Lensed:	Inclusion of small pockets of different soils
Layer:	Inclusion greater than 3 inches thick (75 mm)
Seam:	Inclusion 1/8-inch to 3 inches (3 to 75 mm) thick extending through the sample
Parting:	Inclusion less than 1/8-inch (3 mm) thick

SCALE OF RELATIVE ROCK HARDNESS

Q_U - TSF	Consistency
2.5 - 10	Extremely Soft
10 - 50	Very Soft
50 - 250	Soft
250 - 525	Medium Hard
525 - 1,050	Moderately Hard
1,050 - 2,600	Hard
>2,600	Very Hard

ROCK BEDDING THICKNESSES

Description	Criteria
Very Thick Bedded	Greater than 3-foot (>1.0 m)
Thick Bedded	1-foot to 3-foot (0.3 m to 1.0 m)
Medium Bedded	4-inch to 1-foot (0.1 m to 0.3 m)
Thin Bedded	1¼-inch to 4-inch (30 mm to 100 mm)
Very Thin Bedded	½-inch to 1¼-inch (10 mm to 30 mm)
Thickly Laminated	1/8-inch to ½-inch (3 mm to 10 mm)
Thinly Laminated	1/8-inch or less "paper thin" (<3 mm)

ROCK VOIDS

Voids	Void Diameter
Pit	<6 mm (<0.25 in)
Vug	6 mm to 50 mm (0.25 in to 2 in)
Cavity	50 mm to 600 mm (2 in to 24 in)
Cave	>600 mm (>24 in)

GRAIN-SIZED TERMINOLOGY

(Typically Sedimentary Rock)

Component	Size Range
Very Coarse Grained	>4.76 mm
Coarse Grained	2.0 mm - 4.76 mm
Medium Grained	0.42 mm - 2.0 mm
Fine Grained	0.075 mm - 0.42 mm
Very Fine Grained	<0.075 mm

ROCK QUALITY DESCRIPTION

Rock Mass Description	RQD Value
Excellent	90 -100
Good	75 - 90
Fair	50 - 75
Poor	25 -50
Very Poor	Less than 25

DEGREE OF WEATHERING

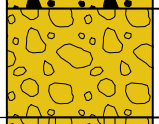
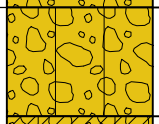
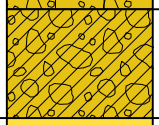
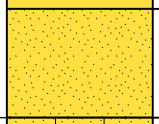
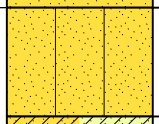
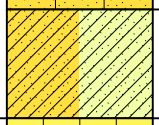
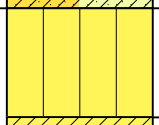
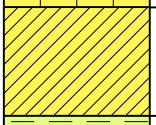
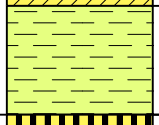
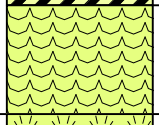
Slightly Weathered: Rock generally fresh, joints stained and discoloration extends into rock up to 25 mm (1 in), open joints may contain clay, core rings under hammer impact.

Weathered: Rock mass is decomposed 50% or less, significant portions of the rock show discoloration and weathering effects, cores cannot be broken by hand or scraped by knife.

Highly Weathered: Rock mass is more than 50% decomposed, complete discoloration of rock fabric, core may be extremely broken and gives clunk sound when struck by hammer, may be shaved with a knife.

SOIL CLASSIFICATION CHART

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	(LITTLE OR NO FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SANDS		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	(LITTLE OR NO FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES		SM	SILTY SANDS, SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

intertek psi

Wis. Dept. of Safety and Professional Services
Division of Industry Services

SOIL EVALUATION - STORM

In accordance with SPS 382.365 & 385, Wis. Adm. Code and WDNR Standard 1002

Attach complete site plan on paper not less that 8 1/2 x 11 inches in size. Plan must include, but not limited to: vertical and horizontal reference point (BM), direction and percent slope, scale or dimensions, north arrow, and BM referenced to nearest road.

Please print all information.

Personal information you provide may be used for secondary purposes [Privacy Law, s. 15.04 (1) (m)].

County: Crawford

Parcel I.D.:

Reviewed by:

Date:

Property Owner	Property Location: Prairie du Chien, WI Govt. Lot

Property Owner's Mailing Address	Lot #	Block #	Subd. Name or CSM#

City	State	Zip Code	Phone Number	☒ City ☐ Village ☐ Town	Nearest Road
				Prairie du Chien	

Drainage area _____ ☐ sq. ft. ☐ acres

Optional:

Test Site Suitable for (check all that apply)

☐ Irrigation ☐ Bioretention trench ☐ Trench(es)

☐ Rain Garden ☐ Grassed swale ☐ Reuse

☐ Infiltration trench ☐ SDS (> 15' wide) ☐ Other _____

Hydraulic Application Test Method:

☒ Morphological Evaluation

☐ Double Ring Infiltrometer

☐ Other (specify)

Soil Moisture

Date of Borings: April 16, 2024

USDA-NRCS WETS Value: 11

☐ **Dry =1;**

☒ **Normal = 2;**

☐ **Wet = 3.**

1 Obs. # ☒ Boring ☐ Pit B-1

Ground surface elevation ± Elevation of limiting factor: 22'±

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	% Fines	Hydraulic App. Rate Inches/Hr.
1	0-48	10YR 2/2		grls	0 m	mfr		>15		1.63
2	48-96	10YR 3/3		s	0 sg	ml		<15		3.6
3	96-138	10YR 6/2		vgrf-ms	0 sg	ml		>35		3.6
4	138-216	10YR 3/3		ms	0 sg	ml		<15		3.6
5	216-324	10YR 4/3		f-ms	0 sg	ml		<15		3.6

Comment: fill soils with miscellaneous debris to 11.5 feet below grade; saturated soils at 22 feet below grade

2 Obs. # ☒ Boring ☐ Pit B-2

Ground surface elevation ± Elevation of limiting factor: 22'±

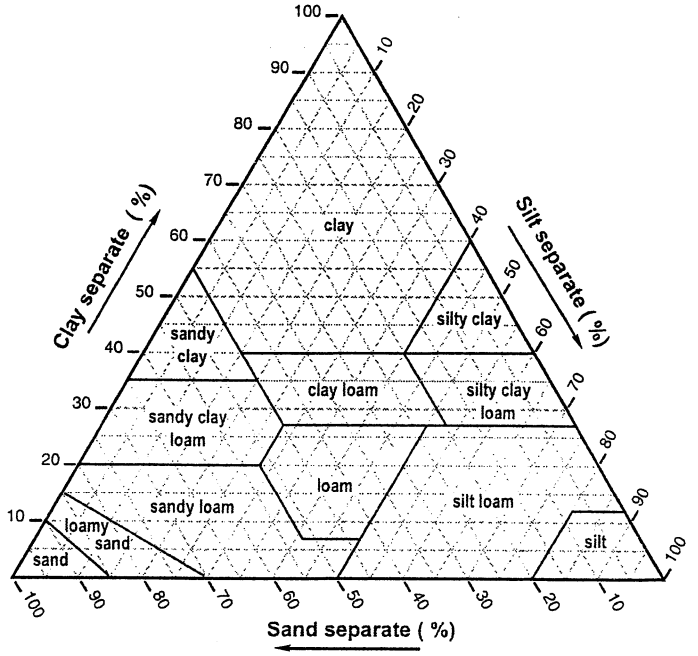
Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	% Fines	Hydraulic App. Rate Inches/Hr.
1	0-24	10YR 2/1		sicl	0 thin pl	mfi		<14		-0.96
2	24-48	10YR 2/2		sicl	1 thin pl	mfi		<15		0.04
3	48-72	10YR 3/2		sic	1 f sbk	mfi		<15		0.07
4	72-144	10YR 5/3		sl	1 f sbk	mfr		<15		0.5
5	144-168	10YR 3/3		grsl	1 f sbk	mfr		>15		0.5
6	168-192	10YR 3/3		grsl	2 f sbk	mfr		>16		1.5
7	192-240	10YR 4/3		grsl	3 f sbk	mfr		>17		2.5
8	240-264	10YR 4/3		grsl	4 f sbk	mfr		>18		3.5
9	264-300	10YR 3/3		grsl	5 f sbk	mfr		>19		4.5

Comment: fill soils with miscellaneous debris to 12.5 feet below grade; saturated soils at 22 feet below grade

CST/PSS Name (Please Print)	Signature	CST/PSS/Geologist Number
Patrick J. Patterson		G-229
Address	**Date Evaluation Conducted**	**Telephone Number**
821 Corporate Court, Waukesha, WI 53189	4/16/2024	262 521 2125

Texture Triangle:

Fine Earth Texture Classes (——)



TEXTURE MODIFIERS - Conventions for using "Rock Fragment Texture Modifiers" and for using textural adjectives that convey the "% volume" ranges for **Rock Fragments - Size and Quantity**.

Fragment Content % By Volume	Rock Fragment Modifier Usage
< 15	No texture adjective is used (noun only; e.g., *loam*).
15 to < 35	Use adjective for appropriate size; e.g., *gravelly.*
35 to < 60	Use "very" with the appropriate size adjective; e.g., *very gravelly.*
60 to < 90	Use "extremely" with the appropriate size adjective; e.g., *extremely gravelly.*
≥ 90	No adjective or modifier. If ≤ 10% fine earth, use the appropriate noun for the dominant size class; e.g., *gravel.* Use **Terms in Lieu of Texture.**

(SOIL) TEXTURE

This is the numerical proportion (percent by weight) of sand, silt, and clay in a soil. Sand, silt, and clay content is estimated in the field by hand (or quantitatively measured in the office/lab by hydrometer or pipette) and then placed within the texture triangle to determine **Texture Class**. Estimate the **Texture Class**; e.g., *sandy loam*; or **Subclass**; e.g., *fine sandy loam* of the fine earth (≤ 2 mm) fraction, or choose a **Term in Lieu of Texture**; e.g., *gravel.* If appropriate, use a **Textural Class Modifier**; e.g., *gravelly silt loam.*

NOTE: **Soil Texture** encompasses only the fine earth fraction (≤ 2 mm). **Particle Size Distribution** (PSD) encompasses the whole soil, including both the fine earth fraction (≤ 2 mm; weight %) and rock fragments (> 2 mm; volume %).

TEXTURE CLASS

Texture Class or Subclass	Code	
	Conv.	NASIS
Coarse Sand	cos	COS
Sand	s	S
Fine Sand	fs	FS
Very Fine Sand	vfs	VFS
Loamy Coarse Sand	lcos	LCOS
Loamy Sand	ls	LS
Loamy Fine Sand	lfs	LFS
Loamy Very Fine Sand	lvfs	LVFS
Coarse Sandy Loam	cosl	COSL
Sandy Loam	sl	SL
Fine Sandy Loam	fsl	FSL
Very Fine Sandy Loam	vfsl	VFSL
Loam	l	L
Silt Loam	sil	SIL
Silt	si	SI
Sandy Clay Loam	scl	SCL
Clay Loam	cl	CL
Silty Clay Loam	sicl	SICL
Sandy Clay	sc	SC
Silty Clay	sic	SIC
Clay	c	C

TEXTURE MODIFIERS - *(adjectives)*

ROCK FRAGMENTS: Size & Quantity [1]	Code		Criteria: Percent (By Volume) of Total Rock Fragments and Dominated By (*name size*): [1]
	Conv.	PDP/ NASIS	
ROCK FRAGMENTS (> 2 mm; ≥ Strongly Cemented)			
Gravelly	GR	GR	≥ 15% but < 35% gravel
Fine Gravelly	FGR	GRF	≥15% but < 35% fine gravel
Medium Gravelly	MGR	GRM	≥15% but < 35% med. gravel
Coarse Gravelly	CGR	GRC	≥ 15% but < 35% coarse gravel
Very Gravelly	VGR	GRV	≥ 35% but < 60% gravel
Extremely Gravelly	XGR	GRX	≥ 60% but < 90% gravel
Cobbly	CB	CB	≥ 15% but < 35% cobbles
Very Cobbly	VCB	CBV	≥ 35% but < 60% cobbles
Extremely Cobbly	XCB	CBX	≥ 60% but < 90% cobbles
Stony	ST	ST	≥ 15% but < 35% stones
Very Stony	VST	STV	≥ 35% but < 60% stones
Extremely Stony	XST	STX	≥ 60% but < 90% stones
Bouldery	BY	BY	≥ 15% but < 35% boulders
Very Bouldery	VBY	BYV	≥ 35% but < 60% boulders
Extremely Bouldery	XBY	BYX	≥ 60% but < 90% boulders
Channery	CN	CN	≥ 15% but < 35% channers
Very Channery	VCN	CNV	≥ 35% but < 60% channers
Extremely Channery	XCN	CNX	≥ 60% but < 90% channers
Flaggy	FL	FL	≥ 15% but < 35% flagstones
Very Flaggy	VFL	FLV	≥ 35% but < 60% flagstones
Extremely Flaggy	XFL	FLX	≥ 60% but < 90% flagstones
PARAROCK FRAGMENTS (> 2 mm; < Strongly Cemented) [2, 3]			
Parabouldery	PBY	PBY	(same criteria as bouldery)
Very Parabouldery	VPBY	PBYV	(same criteria as very bouldery)
Extr. Parabouldery	XPBY	PBYX	(same criteria as ext. bouldery)
etc.	etc.	etc.	(same criteria as non-para)

[1] The "Quantity" modifier (e.g., *very*) is based on the total rock fragment content. The "Size" modifier (e.g., *cobbly*) is independently based on the largest, dominant fragment size. For a mixture of sizes (e.g., *gravel and stones*), a smaller size–class is named only if its quantity (%) sufficiently exceeds that of a larger size–class. For field texture determination, a smaller size-class must exceed 2 times the quantity (vol. %) of a larger size class before it is named (e.g., 30% gravel and 14% stones = *very gravelly*, but 20% gravel and 14% stones = *stony*). For more explicit naming criteria see NSSH-Part 618, Exhibit 618.11(Soil Survey Staff, 2001b).

DOCUMENT 004113 - BID FORM - STIPULATED SUM (SINGLE-PRIME CONTRACT)

1.1 BID INFORMATION

A. Bidder: _____.

B. Project Name: Prairie du Chien Public Safety Facility.

C. Project Location: 705 East Taylor Street, Prairie du Chien, WI.

D. Owner: City of Prairie du Chien.

E. Architect: Short Elliott Hendrickson, Inc.

F. Architect Project Number: PDCAR 177629.

1.2 CERTIFICATIONS AND BASE BID

A. Base Bid, Single-Prime (All Trades) Contract: The undersigned Bidder, having carefully examined the Procurement and Contracting Requirements, Conditions of the Contract, Drawings, Specifications, and all subsequent Addenda, as prepared by Short Elliott Hendrickson, Inc. and Architect's consultants, having visited the site, and being familiar with all conditions and requirements of the Work, hereby agrees to furnish all material, labor, equipment and services, including all scheduled allowances, necessary to complete the construction of the above-named project, according to the requirements of the Procurement and Contracting Documents, for the stipulated sum of:

1. _____ Dollars ($_____).
2. The above amount may be modified by amounts indicated by the Bidder on the attached Document 004322 "Unit Prices Form" and Document 004323 "Alternates Form."

1.3 BID GUARANTEE

A. The undersigned Bidder agrees to execute a contract for this Work in the above amount and to furnish surety as specified within 10 days after a written Notice of Award, if offered within 60 days after receipt of bids, and on failure to do so agrees to forfeit to Owner the attached cash, cashier's check, certified check, U.S. money order, or bid bond, as liquidated damages for such failure, in the following amount constituting five percent (5%) of the Base Bid amount above:

1. _____ Dollars ($_____).

B. In the event Owner does not offer Notice of Award within the time limits stated above, Owner will return to the undersigned the cash, cashier's check, certified check, U.S. money order, or bid bond.

1.4 SUBCONTRACTORS AND SUPPLIERS

A. The following companies shall execute subcontracts for the portions of the Work indicated:

1. Concrete Work: _____.
2. Masonry Work: _____.
3. Roofing Work: _____.
4. Plumbing Work: _____.
5. HVAC Work: _____.
6. Electrical Work: _____.

1.5 TIME OF COMPLETION

A. The undersigned Bidder proposes and agrees hereby to commence the Work of the Contract Documents on a date specified in a written Notice to Proceed to be issued by Architect, and shall fully complete the Work within 330 calendar days.

1.6 ACKNOWLEDGEMENT OF ADDENDA

A. The undersigned Bidder acknowledges receipt of and use of the following Addenda in the preparation of this Bid:

1. Addendum No. 1, dated _____.
2. Addendum No. 2, dated _____.
3. Addendum No. 3, dated _____.
4. Addendum No. 4, dated _____.

1.7 BID SUPPLEMENTS

A. The following supplements are a part of this Bid Form and are attached hereto.

1. Bid Form Supplement - Alternates.
2. Bid Form Supplement - Unit Prices.
3. Bid Form Supplement - Bid Bond Form (AIA Document A310-2010).

1.8 CONTRACTOR'S LICENSE

A. The undersigned further states that it is a duly licensed contractor, for the type of work proposed, in the City of Prairie du Chien, and that all fees, permits, etc., pursuant to submitting this proposal have been paid in full.

1.9 SUBMISSION OF BID

A. Respectfully submitted this ____ day of _____, 2025.

B. Submitted By:_____(Name of bidding firm or corporation).

C. Authorized Signature:_____(Handwritten signature).

D. Signed By:_____(Type or print name).

E. Title:_____(Owner/Partner/President/Vice President).

F. Witnessed By:_____(Handwritten signature).

G. Attest:_____(Handwritten signature).

H. By:_____(Type or print name).

I. Title:_____(Corporate Secretary or Assistant Secretary).

J. Street Address:_____.

K. City, State, Zip:_____.

L. Phone:_____.

M. License No.:_____.

N. Federal ID No.:_____(Affix Corporate Seal Here).

END OF DOCUMENT 004113

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DOCUMENT 004313 - BID SECURITY FORMS

1.1 BID FORM SUPPLEMENT

A. A completed bid bond form is required to be attached to the Bid Form.

1.2 BID BOND FORM

A. AIA Document A310-2010 "Bid Bond" is the recommended form for a bid bond. A bid bond acceptable to Owner, or other bid security as described in the Instructions to Bidders, is required to be attached to the Bid Form as a supplement.

B. Copies of AIA standard forms may be obtained from The American Institute of Architects; https://www.aiacontracts.org/; email: docspurchases@aia.org; (800) 942-7732.

END OF DOCUMENT 004313

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DOCUMENT 004322 - UNIT PRICES FORM

1.1 BID INFORMATION

A. Bidder: _____.

B. Project Name: Prairie du Chien Public Safety Facility.

C. Project Location: 705 East Tayor Street, Prairie du Chien, WI.

D. Owner: City of Prairie du Chien.

E. Architect: Short, Elliott, Hendrickson, Inc.

F. Architect Project Number: PDCAR 177629.

1.2 BID FORM SUPPLEMENT

A. This form is required to be attached to the Bid Form.

B. The undersigned Bidder proposes the amounts below be added to or deducted from the Contract Sum on performance and measurement of the individual items of Work.

C. If the unit price does not affect the Work of this Contract, the Bidder shall indicate "NOT APPLICABLE."

1.3 UNIT PRICES

A. Unit-Price No. 1: Removal of unsatisfactory soil and replacement with satisfactory soil material.

1. _____ dollars ($_____) per unit.

1.4 SUBMISSION OF BID SUPPLEMENT

A. Respectfully submitted this ____ day of _____, 2025.

B. Submitted By:_____(Insert name of bidding firm or corporation).

C. Authorized Signature:_____(Handwritten signature).

D. Signed By:_____(Type or print name).

E. Title:_____(Owner/Partner/President/Vice President).

END OF DOCUMENT 004322

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DOCUMENT 004323 - ALTERNATES FORM

1.1 BID INFORMATION

A. Bidder: _____.

B. Project Name: Prairie du Chien Public Safety Facility.

C. Project Location: 705 East Taylor Street, Prairie du Chien, WI.

D. Owner: City of Prairie du Chien.

E. Architect: Short Elliott Hendrickson, Inc.

F. Architect Project Number: PDCAR 177629.

1.2 BID FORM SUPPLEMENT

A. This form is required to be attached to the Bid Form.

1.3 DESCRIPTION

A. The undersigned Bidder proposes the amount below be added to or deducted from the Base Bid if particular alternates are accepted by Owner. Amounts listed for each alternate include costs of related coordination, modification, or adjustment.

B. If the alternate does not affect the Contract Sum, the Bidder shall indicate "NO CHANGE."

C. If the alternate does not affect the Work of this Contract, the Bidder shall indicate "NOT APPLICABLE."

D. The Bidder shall be responsible for determining from the Contract Documents the affects of each alternate on the Contract Time and the Contract Sum.

E. Owner reserves the right to accept or reject any alternate, in any order, and to award or amend the Contract accordingly within 60days of the Notice of Award unless otherwise indicated in the Contract Documents.

F. Acceptance or non-acceptance of any alternates by the Owner shall have no affect on the Contract Time unless the "Schedule of Alternates" Article below provides a formatted space for the adjustment of the Contract Time.

1.4 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Insulated precast wall panel finish:

1. ADD____ DEDUCT____ NO CHANGE____ NOT APPLICABLE____.

2. _____ Dollars ($_____).
3. ADD____ DEDUCT____ calendar days to adjust the Contract Time for this alternate.

B. Alternate No. 2: Entrance canopy:

1. ADD____ DEDUCT____ NO CHANGE____ NOT APPLICABLE____.
2. _____ Dollars ($_____).
3. ADD____ DEDUCT____ calendar days to adjust the Contract Time for this alternate.

C. Alternate No. 3: Asphalt Paving:

1. ADD____ DEDUCT____ NO CHANGE____ NOT APPLICABLE____.
2. _____ Dollars ($_____).
3. ADD____ DEDUCT____ calendar days to adjust the Contract Time for this alternate.

D. Alternate No. 4: Resinous Flooring – Alternate Manufacturer:

1. ADD____ DEDUCT____ NO CHANGE____ NOT APPLICABLE____.
2. _____ Dollars ($_____).
3. ADD____ DEDUCT____ calendar days to adjust the Contract Time for this alternate.

E. Alternate No. 5: Resinous Flooring - Omit:

1. ADD____ DEDUCT____ NO CHANGE____ NOT APPLICABLE____.
2. _____ Dollars ($_____).
3. ADD____ DEDUCT____ calendar days to adjust the Contract Time for this alternate.

F. Alternate No. 6: Landscaping:

1. ADD____ DEDUCT____ NO CHANGE____ NOT APPLICABLE____.
2. _____ Dollars ($_____).
3. ADD____ DEDUCT____ calendar days to adjust the Contract Time for this alternate.

G. Alternate No. H1: Building Automation – ABB Controls:

1. ADD____ DEDUCT____ NO CHANGE____ NOT APPLICABLE____.
2. _____ Dollars ($_____).
3. ADD____ DEDUCT____ calendar days to adjust the Contract Time for this alternate.

H. Alternate No. H2: Building Automation – Alerton Controls:

1. ADD____ DEDUCT____ NO CHANGE____ NOT APPLICABLE____.
2. _____ Dollars ($_____).
3. ADD____ DEDUCT____ calendar days to adjust the Contract Time for this alternate.

I. Alternate No. H3: Building Automation – Honeywell Controls:

1. ADD____ DEDUCT____ NO CHANGE____ NOT APPLICABLE____.
2. _____ Dollars ($_____).
3. ADD____ DEDUCT____ calendar days to adjust the Contract Time for this alternate.

J. Alternate No. H4: Building Automation – Johnson Controls:

1. ADD____ DEDUCT____ NO CHANGE____ NOT APPLICABLE____.
2. _____ Dollars ($_____).
3. ADD____ DEDUCT____ calendar days to adjust the Contract Time for this alternate.

K. Alternate No. H5: AHU / Condensing unit:

1. ADD____ DEDUCT____ NO CHANGE____ NOT APPLICABLE____.
2. _____ Dollars ($_____).
3. ADD____ DEDUCT____ calendar days to adjust the Contract Time for this alternate.

1.5 SUBMISSION OF BID SUPPLEMENT

A. Respectfully submitted this ____ day of _____, 2025.

B. Submitted By:_____(Insert name of bidding firm or corporation).

C. Authorized Signature:_____(Handwritten signature).

D. Signed By:_____(Type or print name).

E. Title:_____(Owner/Partner/President/Vice President).

END OF DOCUMENT 004323

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DOCUMENT 004373 - PROPOSED SCHEDULE OF VALUES FORM

1.1 BID FORM SUPPLEMENT

A. A completed Proposed Schedule of Values form is required to be attached to the Bid Form.

1.2 PROPOSED SCHEDULE OF VALUES FORM

A. Proposed Schedule of Values Form: Provide a breakdown of the bid amount, including alternates, in enough detail to facilitate continued evaluation of bid. Coordinate with the Project Manual table of contents. Provide multiple line items for principal material and subcontract amounts in excess of five percent of the Contract Sum.

B. Arrange schedule of values using AIA Document G703-1992.

1. Copies of AIA standard forms may be obtained from the American Institute of Architects; https://www.aiacontracts.org/ library; (800) 942-7732.

END OF DOCUMENT 004373

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DOCUMENT 004519 – AFFIDAVIT OF BID CONTENTS

STATE OF _____

COUNTY OF _____

I Hereby swear (or affirm) under the penalty of perjury:

1) That I am the bidder (if the bidder is an individual), a partner in the bidder (if the bidder is a partnership) or an officer or employee of the bidder corporation having authority to sign on its behalf (if the bidder is a corporation);

2) That the attached bid or bids have been arrived at by careful examination of all the Contract documents. The bidder acknowledges responsibility for all contents herewithin;

3) That I have fully informed myself regarding the accuracy of the statements made in this affidavit.

4) The undersigned Bidder expressly understands and agrees to furnish all material, labor, equipment, and services, including all scheduled allowances at no additional cost notwithstanding the undersigned Bidder's failure to comply with the terms in section 1.2(A) of the bid form.

Subscribed and sworn to before me this

_____ day of _____, 20_____

_____
Bidder's Signature

_____
Notary

_____
Title

(Seal)

_____
Company

END OF DOCUMENT 004519

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SECTION 006000 - PROJECT FORMS

1.1 FORM OF AGREEMENT AND GENERAL CONDITIONS

A. The following form of Owner/Contractor Agreement and form of the General Conditions shall be used for Project:

1. AIA Document A101-2017 "Standard Form of Agreement between Owner and Contractor Where the Basis of Payment is a Stipulated Sum."

a. The General Conditions for Project are AIA Document A201-2017 "General Conditions of the Contract for Construction."

2. The General Conditions are incorporated by reference.
3. The Supplementary Conditions for Project are separately prepared and included in the Project Manual.

1.2 ADMINISTRATIVE FORMS

A. Administrative Forms: Additional administrative forms are specified in Division 01 General Requirements.

B. Copies of AIA standard forms may be obtained from the American Institute of Architects; www.aiacontractdocsaiacontracts.org; (800) 942-7732.

C. Preconstruction Forms:

1. Form of Performance Bond and Labor and Material Bond: AIA Document A312-2010 "Performance Bond and Payment Bond."
2. Form of Certificate of Insurance: AIA Document G715-2017 "Supplemental Attachment for ACORD Certificate of Insurance 25."

D. Information and Modification Forms:

1. Form for Requests for Information (RFIs): AIA Document G716-2004 "Request for Information (RFI)."
2. Form of Request for Proposal: AIA Document G709-2018 "Proposal Request."
3. Change Order Form: AIA Document G701-2017 "Change Order."
4. Form of Architect's Memorandum for Minor Changes in the Work: AIA Document G710-2017 "Architect's Supplemental Instructions."
5. Form of Change Directive: AIA Document G714-2017 "Construction Change Directive."

E. Payment Forms:

1. Schedule of Values Form: AIA Document G703-1992 "Continuation Sheet."
2. Payment Application: AIA Document G702-1992/703-1992 "Application and Certificate for Payment and Continuation Sheet."
3. Form of Contractor's Affidavit: AIA Document G706-1994 "Contractor's Affidavit of Payment of Debts and Claims."

4. Form of Affidavit of Release of Liens: AIA Document G706A-1994 "Contractor's Affidavit of Payment of Release of Liens."
5. Form of Consent of Surety: AIA Document G707-1994 "Consent of Surety to Final Payment."

END OF SECTION 006000

SECTION 007210 – GENERAL CONDITIONS

PART 1 GENERAL

1.01 GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION

A. "General Conditions of Contract for Construction," AIA Document A201, is hereby made a part of this Project Manual.
B. Copies of AIA standard forms may be obtained from The American Institute of Architects; https://www.aiacontracts.org/; email: docspurchases@aia.org; (800) 942-7732.

END OF DOCUMENT

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SECTION 007310 – SUPPLEMENTARY CONDITIONS

PART 1 GENERAL – THESE SUPPLEMENTARY CONDITIONS AMEND OR SUPPLEMENT THE STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT, AIA DOCUMENT A201.

1.01 CHANGES IN THE WORK

1. *"Contractor may add a maximum of 3.5 percent for overhead and profit for work performed by sub-contractors and a maximum of 7 percent for self-performed work."*

1.02 PERMITTING

1. The Contractor is responsible for obtaining all permits throughout the construction process. The Owner will pay the fees for the permits.

1.03 OMISSIONS, DISCREPANCIES, AND CORRECTIONS

1. It is the intent of the contract documents that all performance under the contract be in accordance with the best practice. The Contractor shall carefully check the plans both before commencing and throughout the work. Conditions shown on the plans are based on best known information. The City does not assume responsibility for variations. The Contractor is required to make computations to determine the quantities and shall plan the work based on this information. The Contractor shall immediately call the Engineer's attention to any errors, omissions or discrepancies that may be discovered in the plans before proceeding with the work affected. The Engineer reserves the right to make such corrections as deemed necessary for the fulfillment of the true intent of the contract documents.

1.04 WORK TO BE DONE AT CONTRACTOR'S RISK

1. All work to be done under the contract documents from commencement until the final acceptance of such work shall be done entirely at the Contractor's risk. No partial payment for, or partial acceptance of any part of the work shall absolve the Contractor from such risk. The Contractor is responsible for maintaining all traffic control devices as well as sidewalk closure signs and barricades until such time that all hazard areas are removed. It shall be the Contractor's responsibility to protect all work from any vandalism or graffiti.

END OF DOCUMENT 007310

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SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Owner-furnished/Contractor-installed (OFCI) products.
4. Contractor's use of site and premises.
5. Work restrictions.
6. Specification and Drawing conventions.
7. Miscellaneous provisions.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
2. Section 017300 "Execution" for coordination of Owner-installed products.

1.3 DEFINITIONS

A. Work Package: A group of specifications, drawings, and schedules prepared by the design team to describe a portion of the Project Work for pricing, permitting, and construction.

1.4 PROJECT INFORMATION

A. Project Identification: Prairie du Chien Public Safety Facility.

1. Project Location: 705 East Taylor Street, Prairie du Chien, WI.

B. Owner: City of Prairie du Chien.

1. Owner's Representative: Chad Abram.

C. Architect: Short Elliott Hendrickson, Inc..

1. Architect's Representative: Mark Zvitkovits, 425 W. Water Street, Suite 300, Appleton, WI.

D. Web-Based Project Software (Newforma): Project software will be used for purposes of managing communication and documents during the construction stage.

1. See Section 013100 "Project Management and Coordination." for requirements for using web-based Project software.

1.5 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:

1. New construction of a public safety facility housing both Police and Fire Departments. The building will be a fully sprinklered Type IIB construction facility. The exterior walls are constructed with insulated precast concrete wall panels, and the interior walls will be a combination of CMU and metal stud partitions. The roof will be a fully adhered membrane roof, with pitched insulation over metal deck and other Work indicated in the Contract Documents.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

1.6 OWNER-FURNISHED/CONTRACTOR-INSTALLED (OFCI) PRODUCTS

A. Owner's Responsibilities: Owner will furnish products indicated and perform the following, as applicable:

1. Provide to Contractor Owner-reviewed Product Data, Shop Drawings, and Samples.
2. Provide for delivery of Owner-furnished products to Project site.
3. Upon delivery, inspect, with Contractor present, delivered items.

a. If Owner-furnished products are damaged, defective, or missing, arrange for replacement.

4. Obtain manufacturer's inspections, service, and warranties.
5. Inform Contractor of earliest available delivery date for Owner-furnished products.

B. Contractor's Responsibilities: The Work includes the following, as applicable:

1. Designate delivery dates of Owner-furnished products in Contractor's construction schedule, utilizing Owner-furnished earliest available delivery dates.
2. Review Owner-reviewed Product Data, Shop Drawings, and Samples, noting discrepancies and other issues in providing for Owner-furnished products in the Work.
3. Receive, unload, handle, store, protect, and install Owner-furnished products.
4. Make building services connections for Owner-furnished products.
5. Protect Owner-furnished products from damage during storage, handling, and installation and prior to Substantial Completion.
6. Repair or replace Owner-furnished products damaged following receipt.

1.7 CONTRACTOR'S USE OF SITE AND PREMISES

A. Unrestricted Use of Site: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

B. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.8 WORK RESTRICTIONS

A. Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.

B. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances on Project site is not permitted.

1.9 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.

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

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

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings and published as part of the U.S. National CAD Standard.
3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Requirements:

1. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
2. Section 014000 "Quality Requirements" for field testing by an independent testing agency.

1.3 DEFINITIONS

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

1.4 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.

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

D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the Part 3 "Schedule of Unit Prices" Article contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

A. Unit Price No. 1: Removal of unsatisfactory soil and replacement with satisfactory soil material.

1. Description: Unsatisfactory soil excavation and disposal off-site and replacement with satisfactory fill material or engineered fill from off-site, as required, in accordance with Section 312000 "Earth Moving."
2. Unit of Measurement: Cubic yard of soil excavated, based on in-place surveys of volume before and after removal.

END OF SECTION 012200

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include, as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation, whether or not indicated as part of alternate.

B. Execute accepted alternates under the same conditions as other Work of the Contract.

C. Schedule: A Part 3 "Schedule of Alternates" Article is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Insulated precast wall panel finish.

1. Base Bid: Cast thin brick veneer into insulated precast wall panels as indicated on Drawings.
2. Alternate: Sand blast finish insulated precast wall panels where shown to receive cast-in thin brick veneer.

B. Alternate No. 2: Entrance canopy.

1. Base Bid: Install standalone canopy at main building entrance as indicated on Drawings.
2. Alternate: Omit canopy, associated foundations and stormwater piping. Dimensional letter signage to be installed on building façade.

C. Alternate No. 3: Asphalt Paving.

1. Base Bid: Install exterior concrete slabs as indicated on Drawings.
2. Alternate: Install heavy duty asphalt paving in lieu of concrete slabs at East and West Fire Department driveways.

D. Alternate No. 4: Resinous Flooring – Alternate Manufacturer.

1. Base Bid: Install resinous flooring in locations indicated on Drawings per Section 096723.10 – Resinous Flooring-Base Bid.
2. Alternate: Install resinous flooring in locations indicated on the drawings per Section 096723.20 – Resinous Flooring-Alternate.

E. Alternate No. 5: Resinous Flooring - Omit.

1. Base Bid: Install resinous flooring in locations indicated on Drawings per Section 096723.10 – Resinous Flooring-Base Bid.
2. Alternate: Omit resinous flooring. Finish concrete slab with polished finish.

F. Alternate No. 6: Landscaping.

1. Base Bid: Complete Landscape work as indicated on Drawings and in Section 329200 – Turf and Grasses.
2. Alternate: Omit Landscaping Work. Work to be performed by Owner’s staff.

G. Alternate No. H1: Building Automation – ABB Controls

1. Base Bid: Provide work as specified in Divisions 23 and 24 only.
2. Alternate: Provide the Tridium / Niagara Building Automation System specified in Sections 250900 and 250993 as installed by KLPD with ABB Controls

H. Alternate No. H2: Building Automation – Alerton Controls

1. Base Bid: Provide work as specified in Divisions 23 and 24 only.
2. Alternate: Provide the Tridium / Niagara Building Automation System specified in Sections 250900 and 250993 as installed by Masters' Building Solutions with Alerton Controls.

I. Alternate No. H3: Building Automation – Honeywell Controls

1. Base Bid: Provide work as specified in Divisions 23 and 24 only.
2. Alternate: Provide the Tridium / Niagara Building Automation System specified in Sections 250900 and 250993 as installed by Control Works, Inc. with Honeywell Controls.

J. Alternate No. H4: Building Automation – Johnson Controls

1. Base Bid: Provide work as specified in Divisions 23 and 24 only.
2. Alternate: Provide the Tridium / Niagara Building Automation System specified in Sections 250900 and 250993 as installed by HVA products with Johnson F-Ex Controls.

K. Alternate No. H5: AHU / Condensing unit

1. Base Bid: Furnish air handling / condensing units as scheduled.
2. Alternate: Furnish and install Daikin air handling unit and / or condensing unit in lieu of manufacturer as indicated in Sections 237205 and 237313.

END OF SECTION 012300

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SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:

1. Document 002600 "Procurement Substitution Procedures" for requirements for substitution requests prior to award of Contract.
2. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.

1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use CSI Substitution Request Form 1.5C.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.

b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

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

1.6 PROCEDURES

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

1.7 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
b. Substitution request is fully documented and properly submitted.
c. Requested substitution will not adversely affect Contractor's construction schedule.
d. Requested substitution has received necessary approvals of authorities having jurisdiction.
e. Requested substitution is compatible with other portions of the Work.
f. Requested substitution has been coordinated with other portions of the Work.
g. Requested substitution provides specified warranty.
h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Not allowed.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

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SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Requirements:

1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
2. Section 013100 "Project Management and Coordination" for requirements for forms for contract modifications provided as part of web-based Project management software.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710.

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Proposal Request after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

    a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    c. Include costs of labor and supervision directly attributable to the change.
    d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and

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

e. Quotation Form: Use forms acceptable to Architect.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to Architect.

1.5 ADMINISTRATIVE CHANGE ORDERS

A. Unit-Price Adjustment: See Section 012200 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.6 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.7 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

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SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Requirements:

1. Document 004373 "Proposed Schedule of Values Form" for requirements for furnishing proposed schedule of values with bid.
2. Section 012200 "Unit Prices" for administrative requirements governing the use of unit prices.
3. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
4. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.

1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.

B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the schedule of values:

a. Project name and location.
b. Owner's name.
c. Name of Architect.
d. Architect's Project number.
e. Contractor's name and address.
f. Date of submittal.

2. Arrange schedule of values consistent with format of AIA Document G703.
3. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:

a. Related Specification Section or division.
b. Description of the Work.
c. Name of subcontractor.
d. Name of manufacturer or fabricator.
e. Name of supplier.
f. Change Orders (numbers) that affect value.
g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.

1) Labor.
2) Materials.
3) Equipment.

4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

a. Differentiate between items stored on-site and items stored off-site.

6. Overhead Costs, Proportional Distribution: Include total cost and proportionate share of general overhead and profit for each line item.
7. Temporary Facilities: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
8. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.5 APPLICATIONS FOR PAYMENT

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

B. Payment Application Times: The date for each progress payment is indicated in the Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.

1. Other Application for Payment forms proposed by the Contractor may be acceptable to Architect and Owner. Submit forms for approval with initial submittal of schedule of values.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.

E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
3. Provide summary documentation for stored materials indicating the following:

    a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
    b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
    c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

F. Transmittal: Submit electronic signed and notarized original copies of each Application for Payment to Architect.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.

2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.

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

1. List of subcontractors.
2. Schedule of values.
3. Contractor's construction schedule (preliminary if not final).
4. Products list (preliminary if not final).
5. Schedule of unit prices.
6. Submittal schedule (preliminary if not final).
7. List of Contractor's staff assignments.
8. List of Contractor's principal consultants.
9. Copies of building permits.
10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
11. Initial progress report.
12. Report of preconstruction conference.

I. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.

    a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 017700 "Closeout Procedures."

2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

J. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Certification of completion of final punch list items.
3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
4. Updated final statement, accounting for final changes to the Contract Sum.
5. AIA Document G706.
6. AIA Document G706A.
7. AIA Document G707.

8. Evidence that claims have been settled.
9. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
10. Final liquidated damages settlement statement.
11. Proof that taxes, fees, and similar obligations are paid.
12. Waivers and releases.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

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SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:

1. General coordination procedures.
2. Coordination drawings.
3. RFIs.
4. Digital project management procedures.
5. Web-based Project management software package.
6. Project meetings.

B. Related Requirements:

1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

A. BIM: Building Information Modeling.

B. RFI: Request for Information. Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

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

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

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

1. Post copies of list in Project meeting room, in temporary field office, in web-based Project software directory, and in prominent location in built facility. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

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

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

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

1.6 REQUEST FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
2. Architect's Project number.
3. Date.
4. Name of Contractor.

5. RFI number, numbered sequentially.
6. RFI subject.
7. Specification Section number and title and related paragraphs, as appropriate.
8. Drawing number and detail references, as appropriate.
9. Field dimensions and conditions, as appropriate.
10. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
11. Contractor's signature.
12. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms: AIA Document G716.

1. Attachments shall be electronic files in PDF format.

D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:

    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for approval of Contractor's means and methods.
    d. Requests for coordination information already indicated in the Contract Documents.
    e. Requests for adjustments in the Contract Time or the Contract Sum.
    f. Requests for interpretation of Architect's actions on submittals.
    g. Incomplete RFIs or inaccurately prepared RFIs.

2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architectof additional information.
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."

    a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 5 days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect.

4. RFI number, including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.
8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

1.7 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Use of Architect's Digital Data Files: Digital data files of Architect's BIM model will be provided by Architect for Contractor's use during construction.

1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project Record Drawings.
2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
3. Contractor shall execute a data licensing agreement in the form of AIA Document C106 Digital Data Licensing Agreement.

    a. Subcontractors and other parties granted access by Contractor to Architect's digital data files shall execute a data licensing agreement in the form of AIA Document C106.

B. Web-Based Project Management Software Package: Use Architect's web-based Project management software package for purposes of hosting and managing Project communication and documentation until Final Completion.

1. Newforma, Inc.

C. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:

1. Assemble complete submittal package into a single indexed file, incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.8 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of 10 working days prior to meeting.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.

B. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.

1. Conduct the conference to review requirements and responsibilities related to Project closeout.
2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:

    a. Preparation of Record Documents.
    b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
    c. Procedures for completing and archiving web-based Project software site data files.
    d. Submittal of written warranties.
    e. Requirements for preparing operations and maintenance data.
    f. Requirements for delivery of material samples, attic stock, and spare parts.
    g. Requirements for demonstration and training.
    h. Preparation of Contractor's punch list.
    i. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
    j. Submittal procedures.
    k. Owner's partial occupancy requirements.
    l. Installation of Owner's furniture, fixtures, and equipment.
    m. Responsibility for removing temporary facilities and controls.

4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

C. Progress Meetings: Conduct progress meetings at regular intervals.

1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

1) Review schedule for next period.

b. Review present and future needs of each entity present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Status of submittals.
4) Deliveries.
5) Off-site fabrication.
6) Access.
7) Site use.
8) Temporary facilities and controls.
9) Progress cleaning.
10) Quality and work standards.
11) Status of correction of deficient items.
12) Field observations.
13) Status of RFIs.
14) Status of Proposal Requests.
15) Pending changes.
16) Status of Change Orders.
17) Pending claims and disputes.
18) Documentation of information for payment requests.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Startup construction schedule.
2. Contractor's Construction Schedule.
3. Construction schedule updating reports.
4. Daily construction reports.
5. Material location reports.
6. Site condition reports.
7. Unusual event reports.

B. Related Requirements:

1. Section 014000 "Quality Requirements" for schedule of tests and inspections.
2. Section 012900 "Payment Procedures" for schedule of values and requirements for use of cost-loaded schedule for Applications for Payment.

1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.

1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.

C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine the critical path of Project and when activities can be performed.

D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

E. Event: The starting or ending point of an activity.

F. Resource Loading: The allocation of manpower and equipment necessary for completing an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

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

1. Working electronic copy of schedule file.
2. PDF file.

B. Startup construction schedule.

1. Submittal of cost-loaded startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.

C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

D. Construction Schedule Updating Reports: Submit with Applications for Payment.

E. Daily Construction Reports: Submit at weekly intervals.

F. Material Location Reports: Submit at weekly intervals.

G. Site Condition Reports: Submit at time of discovery of differing conditions.

H. Unusual Event Reports: Submit at time of unusual event.

I. Qualification Data: For scheduling consultant.

1.5 QUALITY ASSURANCE

A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's Construction Schedule, including, but not limited to, the following:

1. Review software limitations and content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints, including work stages and interim milestones.
4. Review delivery dates for Owner-furnished products.
5. Review schedule for work of Owner's separate contracts.
6. Review submittal requirements and procedures.
7. Review time required for review of submittals and resubmittals.

8. Review requirements for tests and inspections by independent testing and inspecting agencies.
9. Review time required for Project closeout and Owner startup procedures.
10. Review and finalize list of construction activities to be included in schedule.
11. Review procedures for updating schedule.

1.6 COORDINATION

A. Coordinate Contractor's Construction Schedule with the schedule of values, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities, and schedule them in proper sequence.

1.7 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

B. Time Frame: Extend schedule from date established for the Notice of Award to date of Substantial Completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
2. Temporary Facilities: Indicate start and completion dates for the following as applicable:

    a. Securing of approvals and permits required for performance of the Work.
    b. Temporary facilities.
    c. Construction of mock-ups, prototypes and samples.
    d. Owner interfaces and furnishing of items.
    e. Regulatory agency approvals.
    f. Punch list.

3. Procurement Activities: Include procurement process activities for the following long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.

4. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.

5. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
6. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
7. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and Final Completion.

D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Phasing: Arrange list of activities on schedule by phase.
2. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
3. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
4. Work Restrictions: Show the effect of the following items on the schedule:

    a. Coordination with existing construction.
    b. Limitations of continued occupancies.
    c. Uninterruptible services.
    d. Partial occupancy before Substantial Completion.
    e. Use-of-premises restrictions.
    f. Provisions for future construction.
    g. Seasonal variations.
    h. Environmental control.

5. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:

    a. Structural completion.
    b. Temporary enclosure and space conditioning.
    c. Permanent space enclosure.
    d. Completion of mechanical installation.
    e. Completion of electrical installation.
    f. Substantial Completion.

E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.

1. Temporary enclosure and space conditioning.

F. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.

1. See Section 012900 "Payment Procedures" for cost reporting and payment procedures.

G. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.
2. Unanswered Requests for Information.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.
5. Pending modifications affecting the Work and the Contract Time.

H. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule at each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate Final Completion percentage for each activity.

I. Recovery Schedule: When periodic update indicates the Work is [14] or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.

J. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

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

1.8 STARTUP CONSTRUCTION SCHEDULE

A. Gantt-Chart Schedule: Submit startup, horizontal, Gantt-chart-type construction schedule within seven days of date established for the Notice of Award.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

1.9 GANTT-CHART SCHEDULE REQUIREMENTS

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for the Notice of Award.

1. Base schedule on the startup construction schedule and additional information received since the start of Project.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

1.10 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Testing and inspection.
8. Accidents.
9. Meetings and significant decisions.
10. Unusual events.
11. Stoppages, delays, shortages, and losses.
12. Meter readings and similar recordings.
13. Emergency procedures.
14. Orders and requests of authorities having jurisdiction.
15. Change Orders received and implemented.
16. Construction Change Directives received and implemented.
17. Services connected and disconnected.
18. Equipment or system tests and startups.
19. Partial completions and occupancies.
20. Substantial Completions authorized.

B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:

1. Material stored prior to previous report and remaining in storage.
2. Material stored prior to previous report and since removed from storage and installed.
3. Material stored following previous report and remaining in storage.

C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

D. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

1. Submit unusual event reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013200

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SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

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

1. Preconstruction photographs.
2. Periodic construction photographs.
3. Final Completion construction photographs.

B. Related Requirements:

1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
2. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.2 INFORMATIONAL SUBMITTALS

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

B. Digital Photographs: Submit image files within three days of taking photographs.

1. Submit photos by uploading to web-based Project management software site. Include copy of key plan indicating each photograph's location and direction.
2. Identification: Provide the following information with each image description in web-based Project management software site:

a. Name of Project.
b. Name and contact information for photographer.
c. Name of Architect.
d. Name of Contractor.
e. Date photograph was taken.
f. Description of location, vantage point, and direction.
g. Unique sequential identifier keyed to accompanying key plan.

1.3 FORMATS AND MEDIA

A. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

1.4 CONSTRUCTION PHOTOGRAPHS

A. General: Take photographs with maximum depth of field and in focus.

1. Maintain key plan with each set of construction photographs that identifies each photographic location.

B. Preconstruction Photographs: Before commencement of the Work, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.

C. Periodic Construction Photographs: Take 20 photographs weekly. Select vantage points to show status of construction and progress since last photographs were taken.

D. Final Completion Construction Photographs: Take photographs after date of Substantial Completion for submission as Project Record Documents. Architect will inform photographer of desired vantage points.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013233

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

B. Related Requirements:

1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
3. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
4. Section 013233 "Photographic Documentation" for submitting preconstruction photographs, periodic construction photographs, and Final Completion construction photographs.
5. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
6. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
7. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
8. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
9. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.3 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.

    a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.

4. Format: Arrange the following information in a tabular format:

    a. Scheduled date for first submittal.
    b. Specification Section number and title.
    c. Submittal Category: Action; informational.
    d. Name of subcontractor.
    e. Description of the Work covered.
    f. Scheduled date for Architect's final release or approval.

1.4 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Architect.
4. Name of Contractor.
5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.
7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
8. Category and type of submittal.
9. Submittal purpose and description.
10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
11. Drawing number and detail references, as appropriate.
12. Indication of full or partial submittal.
13. Location(s) where product is to be installed, as appropriate.
14. Other necessary identification.
15. Remarks.

16. Signature of transmitter.

B. Options: Identify options requiring selection by Architect.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. Submittals Utilizing Web-Based Project Software (Newforma): Prepare submittals as PDF files or other format indicated by Project management software.

1.5 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Web-Based Project Management Software (Newforma): Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 15 days for review of each resubmittal.

4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.

D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.6 SUBMITTAL REQUIREMENTS

A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

a. Manufacturer's catalog cuts.
b. Manufacturer's product specifications.
c. Standard color charts.
d. Statement of compliance with specified referenced standards.
e. Testing by recognized testing agency.
f. Application of testing agency labels and seals.
g. Notation of coordination requirements.
h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

a. Wiring diagrams that show factory-installed wiring.
b. Printed performance curves.
c. Operational range diagrams.
d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.

B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

    a. Identification of products.
    b. Schedules.
    c. Compliance with specified standards.
    d. Notation of coordination requirements.
    e. Notation of dimensions established by field measurement.
    f. Relationship and attachment to adjoining construction clearly indicated.
    g. Seal and signature of professional engineer if specified.

2. Paper Sheet Size: Except for templates, patterns, and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm), but no larger than 30 by 42 inches (750 by 1067 mm).

C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.

1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
2. Identification: Permanently attach label on unexposed side of Samples that includes the following:

    a. Project name and submittal number.
    b. Generic description of Sample.
    c. Product name and name of manufacturer.
    d. Sample source.
    e. Number and title of applicable Specification Section.
    f. Specification paragraph number and generic name of each item.

3. Web-Based Project Management Software (Newforma): Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

    a. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.

    a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the

following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned.

1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.

E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

G. Certificates:

1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.

6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

a. Name of evaluation organization.
b. Date of evaluation.
c. Time period when report is in effect.
d. Product and manufacturers' names.
e. Description of product.
f. Test procedures and results.
g. Limitations of use.

1.7 DELEGATED DESIGN SERVICES

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

1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.8 CONTRACTOR'S REVIEW

A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp or indication in web-based Project management software. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 ARCHITECT'S REVIEW

A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required.

1. Submittals by Web-Based Project Management Software (Newforma): Architect will indicate, on Project management software website, the appropriate action.

a. Actions taken by indication on Project management software website have the following meanings:

B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Architect will discard submittals received from sources other than Contractor.

F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

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SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

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

1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.3 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.

1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).

D. Mockups: Physical assemblies of portions of the Work constructed to establish the standard by which the Work will be judged. Mockups are not Samples.

1. Mockups are used for one or more of the following:

    a. Verify selections made under Sample submittals.
    b. Demonstrate aesthetic effects.
    c. Demonstrate the qualities of products and workmanship.
    d. Demonstrate successful installation of interfaces between components and systems.
    e. Perform preconstruction testing to determine system performance.

2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.

E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.

F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."

I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.4 DELEGATED DESIGN SERVICES

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

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

B. Delegated Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.5 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.6 ACTION SUBMITTALS

A. Mockup Shop Drawings:

1. Include plans, sections, elevations, and details, indicating materials and size of mockup construction.
2. Indicate manufacturer and model number of individual components.
3. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.7 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data: For Contractor's quality-control personnel.

C. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

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

1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.

5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

E. Reports: Prepare and submit certified written reports and documents as specified.

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

1.8 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice of Award, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities and to coordinate Owner's quality-assurance and quality-control activities. Coordinate with Contractor's Construction Schedule.

B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.

1. Project quality-control manager may also serve as Project superintendent.

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:

1. Contractor-performed tests and inspections, including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring the Work into compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports, including log of approved and rejected results. Include Work Architect has indicated as nonconforming or

defective. Indicate corrective actions taken to bring nonconforming Work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.9 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, telephone number, and email address of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement of whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement of whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

1.10 QUALITY ASSURANCE

A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and engage in the activities indicated.

1. Requirements of authorities having jurisdiction supersede requirements for specialists.

G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups of size indicated.
2. Build mockups in location indicated or, if not indicated, as directed by Architect.
3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
5. Demonstrate the proposed range of aesthetic effects and workmanship.
6. Obtain Architect's approval of mockups before starting corresponding Work, fabrication, or construction.

    a. Allow seven days for initial review and each re-review of each mockup.

7. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
10. Demolish and remove mockups when directed unless otherwise indicated.

1.11 QUALITY CONTROL

A. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Engage a qualified testing agency to perform quality-control services.

    a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

B. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

C. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform duties of Contractor.

D. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

E. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

F. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspection equipment at Project site.

G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

H. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's Construction Schedule. Update and submit with each Application for Payment.

1. Schedule Contents: Include tests, inspections, and quality-control services, including Contractor- and Owner-retained services, commissioning activities, and other Project-required services paid for by other entities.
2. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's and authorities' having jurisdiction reference during normal working hours.

1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

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SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

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

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms, including "requested," "authorized," "selected," "required," and "permitted," have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms, including "shown," "noted," "scheduled," and "specified," have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

1. For standards referenced by applicable building codes, comply with dates of standards as listed in building codes.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.3 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

B. Industry Organizations, List: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. Abbreviations and acronyms not included in this list are to mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States." The information in this list is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. AABC - Associated Air Balance Council; www.aabc.com.
2. AAMA - American Architectural Manufacturers Association; (see FGIA).
3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
7. ABMA - American Boiler Manufacturers Association; www.abma.com.
8. ACI - American Concrete Institute; www.concrete.org.
9. ACP - American Clean Power; (Formerly: American Wind Energy Association); www.cleanpower.org.
10. ACPA - American Concrete Pipe Association; www.concretepipe.org.
11. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
12. AF&PA - American Forest & Paper Association; www.afandpa.org.
13. AGA - American Gas Association; www.aga.org.
14. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
15. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
16. AI - Asphalt Institute; www.asphaltinstitute.org.
17. AIA - American Institute of Architects (The); www.aia.org.
18. AISC - American Institute of Steel Construction; www.aisc.org.
19. AISI - American Iron and Steel Institute; www.steel.org.
20. AITC - American Institute of Timber Construction; (see PLIB).
21. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
22. AMPP - Association for Materials Protection and Performance; www.ampp.org.
23. ANSI - American National Standards Institute; www.ansi.org.
24. AOSA/SCST - Association of Official Seed Analysts (The)/Society of Commercial Seed Technologists (The); www.analyzeseeds.com.
25. APA - APA - The Engineered Wood Association; www.apawood.org.

26. APA - Architectural Precast Association; www.archprecast.org.
27. API - American Petroleum Institute; www.api.org.
28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
29. ASA - Acoustical Society of America; www.acousticalsociety.org.
30. ASCE - American Society of Civil Engineers; www.asce.org.
31. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (see ASCE).
32. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
33. ASME - ASME International; American Society of Mechanical Engineers (The); www.asme.org.
34. ASSE - ASSE International; (American Society of Sanitary Engineering); www.asse-plumbing.org.
35. ASSP - American Society of Safety Professionals; www.assp.org.
36. ASTM - ASTM International; www.astm.org.
37. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
38. AVIXA - Audiovisual and Integrated Experience Association; www.avixa.org.
39. AWI - Architectural Woodwork Institute; www.awinet.org.
40. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
41. AWPA - American Wood Protection Association; www.awpa.com.
42. AWS - American Welding Society; www.aws.org.
43. AWWA - American Water Works Association; www.awwa.org.
44. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
45. BIA - Brick Industry Association (The); www.gobrick.com.
46. BICSI - BICSI, Inc.; www.bicsi.org.
47. BIFMA - Business and Institutional Furniture Manufacturer's Association; www.bifma.org.
48. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
49. BWF - Badminton World Federation; www.bwfbadminton.com.
50. CARB - California Air Resources Board; www.arb.ca.gov.
51. CDA - Copper Development Association Inc.; www.copper.org.
52. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
53. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
54. CGA - Compressed Gas Association; www.cganet.com.
55. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
56. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
57. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
58. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
59. CPA - Composite Panel Association; www.compositepanel.org.
60. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
61. CRRC - Cool Roof Rating Council; www.coolroofs.org.
62. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
63. CSA - CSA Group; www.csagroup.org.
64. CSI - Cast Stone Institute; www.caststone.org.
65. CSI - Construction Specifications Institute (The); www.csiresources.org.
66. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
67. CTA - Consumer Technology Association; www.cta.tech.
68. CTI - Cooling Technology Institute; www.coolingtechnology.org.
69. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
70. DHA - Decorative Hardwoods Association; www.decorativehardwoods.org.

71. DHI - Door and Hardware Institute; www.dhi.org.
72. ECIA - Electronic Components Industry Association; www.ecianow.org.
73. EIMA - EIFS Industry Members Association; www.eima.com.
74. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
75. EOS/ESD - EOS/ESD Association, Inc.; Electrostatic Discharge Association; www.esda.org.
76. ESTA - Entertainment Services and Technology Association; www.esta.org.
77. EVO - Efficiency Valuation Organization; www.evo-world.org.
78. FCI - Fluid Controls Institute; www.fluidcontrolsinstitute.org.
79. FGIA - Fenestration and Glazing Industry Alliance; https://fgiaonline.org.
80. FM Approvals - FM Approvals LLC; www.fmapprovals.com.
81. FM Global - FM Global; www.fmglobal.com.
82. FRSA - Florida Roofing and Sheet Metal Contractors Association, Inc.; www.floridaroof.com.
83. FSA - Fluid Sealing Association; www.fluidsealing.com.
84. FSC - Forest Stewardship Council U.S.; www.fscus.org.
85. GA - Gypsum Association; www.gypsum.org.
86. GS - Green Seal; www.greenseal.org.
87. HI - Hydraulic Institute; www.pumps.org.
88. HMMA - Hollow Metal Manufacturers Association; (see NAAMM).
89. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
90. IAS - International Accreditation Service; www.iasonline.org.
91. ICC - International Code Council; www.iccsafe.org.
92. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
93. ICPA - International Cast Polymer Association (The); www.theicpa.com.
94. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
95. IEC - International Electrotechnical Commission; www.iec.ch.
96. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
97. IES - Illuminating Engineering Society; www.ies.org.
98. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
99. IGMA - Insulating Glass Manufacturers Alliance; (see FGIA).
100. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.org.
101. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
102. Intertek - Intertek Group; www.intertek.com.
103. ISA - International Society of Automation (The); www.isa.org.
104. ISFA - International Surface Fabricators Association; www.isfanow.org.
105. ISO - International Organization for Standardization; www.iso.org.
106. ITU - International Telecommunication Union; www.itu.int.
107. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
108. LPI - Lightning Protection Institute; www.lightning.org.
109. MBMA - Metal Building Manufacturers Association; www.mbma.com.
110. MCA - Metal Construction Association; www.metalconstruction.org.
111. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
112. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
113. MHI - Material Handling Industry; www.mhi.org.
114. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
115. MPI - Master Painters Institute; www.paintinfo.com.
116. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry, Inc.; www.msshq.org.
117. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.

118. NACE - NACE International; (National Association of Corrosion Engineers International); (see AMPP).
119. NADCA - National Air Duct Cleaners Association; www.nadca.com.
120. NAIMA - North American Insulation Manufacturers Association; www.insulationinstitute.org.
121. NALP - National Association of Landscape Professionals; www.landscapeprofessionals.org.
122. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
123. NBI - New Buildings Institute; www.newbuildings.org.
124. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
125. NCMA - National Concrete Masonry Association; www.ncma.org.
126. NEBB - National Environmental Balancing Bureau; www.nebb.org.
127. NECA - National Electrical Contractors Association; www.necanet.org.
128. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
129. NEMA - National Electrical Manufacturers Association; www.nema.org.
130. NETA - InterNational Electrical Testing Association; www.netaworld.org.
131. NFHS - National Federation of State High School Associations; www.nfhs.org.
132. NFPA - National Fire Protection Association; www.nfpa.org.
133. NFPA - NFPA International; (see NFPA).
134. NFRC - National Fenestration Rating Council; www.nfrc.org.
135. NGA - National Glass Association; www.glass.org.
136. NHLA - National Hardwood Lumber Association; www.nhla.com.
137. NLGA - National Lumber Grades Authority; www.nlga.org.
138. NOFMA - National Oak Flooring Manufacturers Association; (see NWFA).
139. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
140. NRCA - National Roofing Contractors Association; www.nrca.net.
141. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
142. NSF - NSF International; www.nsf.org.
143. NSI - Natural Stone Institute; www.naturalstoneinstitute.org.
144. NSPE - National Society of Professional Engineers; www.nspe.org.
145. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
146. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
147. NWFA - National Wood Flooring Association; www.nwfa.org.
148. NWRA - National Waste & Recycling Association; www.wasterecycling.org.
149. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
150. PDI - Plumbing & Drainage Institute; www.pdionline.org.
151. PLASA - PLASA; www.plasa.org.
152. PLIB - Pacific Lumber Inspection Bureau; www.plib.org.
153. PVCPA - Uni-Bell PVC Pipe Association; www.uni-bell.org.
154. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
155. RFCI - Resilient Floor Covering Institute; www.rfci.com.
156. RIS - Redwood Inspection Service; (see WWPA).
157. SAE - SAE International; www.sae.org.
158. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
159. SDI - Steel Deck Institute; www.sdi.org.
160. SDI - Steel Door Institute; www.steeldoor.org.
161. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
162. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (see ASCE).
163. SIA - Security Industry Association; www.securityindustry.org.
164. SJI - Steel Joist Institute; www.steeljoist.org.

165. SMA - Screen Manufacturers Association; www.smainfo.org.
166. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
167. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
168. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
169. SPIB - Southern Pine Inspection Bureau; www.spib.org.
170. SPRI - Single Ply Roofing Industry; www.spri.org.
171. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
172. SSINA - Specialty Steel Industry of North America; www.ssina.com.
173. SSPC - SSPC: The Society for Protective Coatings; (see AMPP).
174. STI/SPFA - Steel Tank Institute/Steel Plate Fabricators Association; www.steeltank.com.
175. SWI - Steel Window Institute; www.steelwindows.com.
176. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
177. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
178. TCNA - Tile Council of North America, Inc.; www.tcnatile.com.
179. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.kbcdco.tema.org.
180. TIA - Telecommunications Industry Association (The); www.tiaonline.org.
181. TMS - The Masonry Society; www.masonrysociety.org.
182. TPI - Truss Plate Institute; www.tpinst.org.
183. TPI - Turfgrass Producers International; www.turfgrasssod.org.
184. TRI - Tile Roofing Industry Alliance; www.tileroofing.org.
185. UL - Underwriters Laboratories Inc.; www.ul.org.
186. UL LLC - UL LLC; www.ul.com.
187. USAV - USA Volleyball; www.usavolleyball.org.
188. USGBC - U.S. Green Building Council; www.usgbc.org.
189. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
190. WA - Wallcoverings Association; www.wallcoverings.org.
191. WCLIB - West Coast Lumber Inspection Bureau; (see PLIB).
192. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
193. WDMA - Window & Door Manufacturers Association; www.wdma.com.
194. WI - Woodwork Institute; www.woodworkinstitute.com.
195. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
196. WWPA - Western Wood Products Association; www.wwpa.org.

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
2. ICC - International Code Council; www.iccsafe.org.
3. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.

1. CPSC - U.S. Consumer Product Safety Commission; www.cpsc.gov.
2. DOC - U.S. Department of Commerce; www.commerce.gov.
3. DOD - U.S. Department of Defense; www.defense.gov.
4. DOE - U.S. Department of Energy; www.energy.gov.

5. DOJ - U.S. Department of Justice; www.ojp.usdoj.gov
6. DOS - U.S. Department of State; www.state.gov.
7. EPA - United States Environmental Protection Agency; www.epa.gov.
8. FAA - Federal Aviation Administration; www.faa.gov.
9. GPO - U.S. Government Publishing Office; www.gpo.gov.
10. GSA - U.S. General Services Administration; www.gsa.gov.
11. HUD - U.S. Department of Housing and Urban Development; www.hud.gov.
12. LBNL - Lawrence Berkeley National Laboratory; Energy Technologies Area; www.lbl.gov/.
13. NIST - National Institute of Standards and Technology; www.nist.gov.
14. OSHA - Occupational Safety & Health Administration; www.osha.gov.
15. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
16. USACE - U.S. Army Corps of Engineers; www.usace.army.mil.
17. USDA - U.S. Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
18. USDA - U.S. Department of Agriculture; Rural Utilities Service; www.usda.gov.
19. USP - U.S. Pharmacopeial Convention; www.usp.org.
20. USPS - United States Postal Service; www.usps.com.

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CFR - Code of Federal Regulations; Available from U.S. Government Publishing Office; www.govinfo.gov.
2. DOD - U.S. Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.dsp.dla.mil/Specs-Standards/.
3. DSCC - Defense Supply Center Columbus; (see FS).
4. FED-STD - Federal Standard; (see FS).
5. FS - Federal Specification; Available from DLA Document Services; www.dsp.dla.mil/Specs-Standards/.

    a. Available from Defense Standardization Program; www.dsp.dla.mil.
    b. Available from U.S. General Services Administration; www.gsa.gov.
    c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org.
6. USAB - United States Access Board; www.access-board.gov.
7. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (see USAB).

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

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SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

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

B. Related Requirements:

1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.2 USE CHARGES

A. Installation, removal, and use charges for temporary facilities to be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Architect, testing agencies, and authorities having jurisdiction.

B. Sewer Service: Owner will pay sewer-service use charges for sewer usage by all entities for construction operations.

C. Water Service: Owner will pay water-service use charges for water used by all entities for construction operations.

D. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations.

1.3 INFORMATIONAL SUBMITTALS

A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.

B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.

C. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.

D. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

E. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.

1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
3. Indicate methods to be used to avoid trapping water in finished work.

F. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:

1. Locations of dust-control partitions at each phase of work.
2. HVAC system isolation schematic drawing.
3. Location of proposed air-filtration system discharge.
4. Waste-handling procedures.
5. Other dust-control measures.

1.4 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

C. Accessible Temporary Egress: Comply with applicable provisions in the DOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

1.5 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. Portable Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.8-mm-) thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized-steel

pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top and bottom rails. Provide galvanized-steel bases for supporting posts.

B. Fencing Windscreen Privacy Screen: Polyester fabric scrim with grommets for attachment to chain-link fence, sized to height of fence, in color selected by Architect from manufacturer's standard colors.

C. Wood Enclosure Fence: Plywood, [**6 feet (1.8 m)**] [**8 feet (2.4 m)**] high, framed with four 2-by-4-inch (50-by-100-mm) rails, with preservative-treated wood posts spaced not more than 8 feet (2.4 m) apart.

D. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil (0.25-mm) minimum thickness, with flame-spread rating of 15 or less in accordance with ASTM E84 and passing NFPA 701 Test Method 2.

E. Dust-Control Adhesive-Surface Walk-Off Mats: Provide mats, minimum 36 by 60 inches (914 by 1524 mm).

F. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

2.2 TEMPORARY FACILITIES

A. Field Offices:

1. Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.

C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

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

3.2 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.3 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

C. Water Service:

1. Install water service and distribution piping in sizes and pressures adequate for construction.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.

F. Electric Power Service:

1. Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
2. Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

a. Install electric power service underground unless otherwise indicated.

G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

H. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install WiFi cell phone access equipment and one land-based telephone line(s) for each field office.

1. Provide additional telephone lines for the following:

a. Provide one telephone line(s) for Owner's use.

2. At each telephone, post a list of important telephone numbers.

a. Police and fire departments.
b. Ambulance service.
c. Contractor's home office.
d. Contractor's emergency after-hours telephone number.
e. Architect's office.
f. Engineers' offices.
g. Owner's office.
h. Principal subcontractors' field and home offices.

I. Electronic Communication Service: Provide secure WiFi wireless connection to internet with provisions for access by Architect and Owner.

3.4 SUPPORT FACILITIES INSTALLATION

A. Comply with the following:

1. Provide construction for temporary field offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines that is noncombustible in accordance with ASTM E136. Comply with NFPA 241.
2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial

Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain, including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

C. Parking: Provide temporary offsite parking areas for construction personnel.

D. Storage and Staging: Use designated areas of Project site for storage and staging needs.

E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Identification Signs: Provide Project identification signs as indicated on Drawings.
2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.

a. Provide temporary, directional signs for construction personnel and visitors.

3. Maintain and touch up signs, so they are legible at all times.

G. Waste Disposal Facilities:

1. Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

1. Comply with work restrictions specified in Section 011000 "Summary."

B. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

C. Tree and Plant Protection:

1. Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

D. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals, so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.

E. Site Enclosure Fence: Prior to commencing earthwork, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.

1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.

F. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.

G. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

H. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.

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

1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

3.6 MOISTURE AND MOLD CONTROL

A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.

B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

1. Protect porous materials from water damage.
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.
5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard and replace stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.

D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

    a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective and require replacing.
    b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
    c. Remove and replace materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.7 OPERATION, TERMINATION, AND REMOVAL

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

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been

delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

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SECTION 015723 - TEMPORARY STORM WATER POLLUTION CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Temporary stormwater pollution controls.

1.3 STORMWATER POLLUTION PREVENTION PLAN

A. The Stormwater Pollution Prevention Plan (SWPPP) is part of the Contract Documents and is bound into this Project Manual.

1.4 INFORMATIONAL SUBMITTALS

A. Stormwater Pollution Prevention Plan (SWPP): Within 15 days of date established for commencement of the Work, submit completed SWPPP.

B. EPA authorization under the EPA's "2017 Construction General Permit (CGP)."

C. Stormwater Pollution Prevention (SWPP) Training Log: For each individual performing Work under the SWPPP.

D. Inspection reports.

1.5 QUALITY ASSURANCE

A. Stormwater Pollution Prevention Plan (SWPPP) Coordinator: Experienced individual or firm with a record of successful water pollution control management coordination of projects with similar requirements.

1. SWPPP Coordinator shall complete and finalize the SWPPP form.
2. SWPPP Coordinator shall be responsible for inspections and maintaining of all requirements of the SWPPP.

B. Installers: Trained as indicated in the SWPPP.

PART 2 - PRODUCTS

2.1 TEMPORARY STORMWATER POLLUTION CONTROLS

A. Provide temporary stormwater pollution controls as required by the SWPPP.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with all best management practices, general requirements, performance requirements, reporting requirements, and all other requirements included in the SWPPP.

B. Locate stormwater pollution controls in accordance with the SWPPP.

C. Conduct construction as required to comply with the SWPPP and that minimize possible contamination or pollution or other undesirable effects.

1. Inspect, repair, and maintain SWPPP controls during construction.

a. Inspect all SWPPP controls not less than every seven days, and after each occurrence of a storm event, as outlined in the SWPPP.

D. Remove SWPPP controls at completion of construction and restore and stabilize areas disturbed during construction.

END OF SECTION 015723

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of This Section Includes: Administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

B. Related Requirements:

1. Section 011000 "Summary" for Contractor requirements related to Owner-furnished products.
2. Section 012300 "Alternates" for products selected under an alternate.
3. Section 012500 "Substitution Procedures" for requests for substitutions.
4. Section 014200 "References" for applicable industry standards for products specified.
5. Section 017700 "Closeout Procedures" for submitting warranties.

1.2 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products unless otherwise indicated.
3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.

1. Evaluating Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements

for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.

C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.

D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:

1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
2. Data indicating compliance with the requirements specified in "Comparable Products" Article.

E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."

F. Substitution: Refer to Section 012500 "Substitution Procedures" for definition and limitations on substitutions.

1.3 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is inconspicuous.
2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:

a. Name of product and manufacturer.
b. Model and serial number.
c. Capacity.
d. Speed.
e. Ratings.

3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

1.4 COORDINATION

A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.

C. Storage:

1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
2. Store products to allow for inspection and measurement of quantity or counting of units.
3. Store materials in a manner that will not endanger Project structure.
4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.

1.6 PRODUCT WARRANTIES

A. Warranties specified in other Sections are to be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of Owner or endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of Owner or endorsed by manufacturer to Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

    a. Submit additional documentation required by Architect in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by Architect, whose determination is final.

B. Product Selection Procedures:

1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

    a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."

2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

    a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."

3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

    a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."

4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.

    a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
    b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.

5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

    a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."

6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.

    a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
    b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.

7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

    a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.

C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:

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

B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for a comparable product. Architect will notify Contractor of approval or rejection of proposed comparable product within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

1. Architect's Approval of Submittal: See Section 013300 "Submittal Procedures."

2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

C. Submittal Requirements, Two-Step Process: Approval by Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

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SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:

1. Construction layout.
2. Field engineering.
3. Installation.
4. Cutting and patching.
5. Coordination of Owner's portion of the Work.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.
9. Correction of the Work.

B. Related Requirements:

1. Section 011000 "Summary" for limits on use of Project site.
2. Section 013300 "Submittal Procedures" for submitting surveys.
3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
4. Section 078413 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.2 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For land surveyor.

B. Certified Surveys: Submit two copies signed by land surveyor.

C. Certificates: Submit certificate signed by land surveyor, certifying that location and elevation of improvements comply with requirements.

D. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.4 CLOSEOUT SUBMITTALS

A. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.5 QUALITY ASSURANCE

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

B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:

    a. Primary operational systems and equipment.
    b. Fire separation assemblies.
    c. Air or smoke barriers.
    d. Fire-suppression systems.
    e. Plumbing piping systems.
    f. Mechanical systems piping and ducts.
    g. Control systems.
    h. Communication systems.
    i. Fire-detection and -alarm systems.
    j. Electrical wiring systems.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:

    a. Water, moisture, or vapor barriers.
    b. Membranes and flashings.
    c. Exterior curtain-wall construction.
    d. Sprayed fire-resistive material.
    e. Equipment supports.

f. Piping, ductwork, vessels, and equipment.
g. Noise- and vibration-control elements and systems.

4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with requirements specified in other Sections.

1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect promptly.

B. Engage a land surveyor experienced in laying out the Work, using the following accepted surveying practices:

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.

4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

E. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

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

3.5 INSTALLATION

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb, and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces, unless otherwise indicated on Drawings.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.

F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.

G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

3.6 CUTTING AND PATCHING

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

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Temporary Support: Provide temporary support of Work to be cut.

C. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

D. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

E. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

    a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

F. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 PROGRESS CLEANING

A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, in accordance with regulations.

    a. Use containers intended for holding waste materials of type to be stored.

4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces in accordance with written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

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

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.9 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.10 CORRECTION OF THE WORK

A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.

C. Restore permanent facilities used during construction to their specified condition.

D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

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

END OF SECTION 017300

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1. Salvaging nonhazardous construction waste.
2. Recycling nonhazardous construction waste.
3. Disposing of nonhazardous construction waste.

1.3 DEFINITIONS

A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner’s property.

C. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

1.4 MATERIALS OWNERSHIP

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

1.5 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 7 days of date established for the Notice of Award.

1.6 INFORMATIONAL SUBMITTALS

A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Use Form CWM-7 for construction waste. Include the following information:

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

B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

G. Qualification Data: For waste management coordinator.

H. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.7 QUALITY ASSURANCE

A. Waste Management Coordinator Qualifications: Experienced firm, or individual employed and assigned by General Contractor, with a record of successful waste management coordination of projects with similar requirements. Superintendent may serve as Waste Management Coordinator.

B. Regulatory Requirements: Comply with transportation and disposal regulations of authorities having jurisdiction.

C. Waste Management Conference(s): Conduct conference(s) at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:

1. Review and discuss waste management plan including responsibilities of each contractor and waste management coordinator.

2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

1.8 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of site-clearing and construction waste generated by the Work. Use Form CWM-1 for construction waste. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Use Form CWM-3 for construction waste. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
2. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
3. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there were no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Use Form CWM-5 for construction waste. Include the following:

1. Total quantity of waste.
2. Estimated cost of disposal (cost per unit). Include transportation and tipping fees and cost of collection containers and handling for each type of waste.
3. Total cost of disposal (with no waste management).
4. Revenue from salvaged materials.
5. Revenue from recycled materials.
6. Savings in transportation and tipping fees by donating materials.
7. Savings in transportation and tipping fees that are avoided.
8. Handling and transportation costs. Include cost of collection containers for each type of waste.
9. Net additional cost or net savings from waste management plan.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."

B. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.
2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 RECYCLING CONSTRUCTIONWASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.

C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.

5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

3.3 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

D. Paint: Seal containers and store by type.

3.4 DISPOSAL OF WASTE

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

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. General: Except for items or materials to be salvaged or recycled, remove waste materials and legally dispose of at designated spoil areas on Owner’s property.

C. Burning: Do not burn waste materials.

END OF SECTION 017419

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SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final Completion procedures.
3. List of incomplete items.
4. Submittal of Project warranties.
5. Final cleaning.

B. Related Requirements:

1. Section 012900 "Payment Procedures" for requirements for Applications for Payment for Substantial Completion and Final Completion.
2. Section 013233 "Photographic Documentation" for submitting Final Completion construction photographic documentation.
3. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
4. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
5. Section 017900 "Demonstration and Training" for requirements to train Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.2 DEFINITIONS

A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is substantially complete.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of cleaning agent.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest-control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.

    a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.

5. Submit testing, adjusting, and balancing records.
6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.

4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
6. Advise Owner of changeover in utility services.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements.
10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.7 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:

1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list will state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

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

1.8 LIST OF INCOMPLETE ITEMS

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor, listed by room or space number.
2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

    a. Project name.
    b. Date.
    c. Name of Architect.
    d. Name of Contractor.
    e. Page number.

4. Submit list of incomplete items in the following format:

    a. PDF Electronic File: Architect will return annotated file.
    b. Web-Based Project Software Upload: Utilize software feature for creating and updating list of incomplete items (punch list).

1.9 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

C. Warranties in Paper Form:

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (215-by-280-mm) paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Clean flooring, removing debris, dirt, and staining; clean in accordance with manufacturer's instructions.
i. Vacuum and mop concrete.
j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean in accordance with manufacturer's instructions if visible soil or stains remain.
k. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
l. Remove labels that are not permanent.

m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
p. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.

1) Clean HVAC system in compliance with NADCA ACR. Provide written report on completion of cleaning.

q. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
r. Clean strainers.
s. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.

D. Construction Waste Disposal: Comply with waste-disposal requirements in Section 017419 "Construction Waste Management and Disposal."

3.2 CORRECTION OF THE WORK

A. Complete repair and restoration operations required by "Correction of the Work" Article in Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory manuals.
2. Emergency manuals.
3. Systems and equipment operation manuals.
4. Systems and equipment maintenance manuals.
5. Product maintenance manuals.

B. Related Requirements:

1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Architect will comment on whether content of operation and maintenance submittals is acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operation and maintenance manuals in the following format:

1. Submit on digital media acceptable to Architect. Enable reviewer comments on draft submittals.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.

1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.

E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.

5. Name and contact information for Contractor.
6. Name and contact information for Construction Manager.
7. Name and contact information for Architect.
8. Name and contact information for Commissioning Authority.
9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
10. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.7 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:

1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.8 EMERGENCY MANUALS

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.

3. Emergency procedures.

C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

E. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

1.9 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.

9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.10 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.

C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

    a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

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

J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of maintenance manuals.

1.11 PRODUCT MAINTENANCE MANUALS

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

E. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.
2. Record specifications.
3. Record Product Data.
4. Miscellaneous record submittals.

B. Related Requirements:

1. Section 017300 "Execution" for final property survey.
2. Section 017700 "Closeout Procedures" for general closeout procedures.
3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set(s) of marked-up record prints.

B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and Contract modifications.

C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

1.4 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

    a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    b. Accurately record information in an acceptable drawing technique.
    c. Record data as soon as possible after obtaining it.
    d. Record and check the markup before enclosing concealed installations.
    e. Cross-reference record prints to corresponding photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

    a. Dimensional changes to Drawings.
    b. Revisions to details shown on Drawings.
    c. Depths of foundations.
    d. Locations and depths of underground utilities.
    e. Revisions to routing of piping and conduits.
    f. Revisions to electrical circuitry.
    g. Actual equipment locations.
    h. Duct size and routing.
    i. Locations of concealed internal utilities.
    j. Changes made by Change Order or Construction Change Directive.
    k. Changes made following Architect's written orders.
    l. Details not on the original Contract Drawings.
    m. Field records for variable and concealed conditions.
    n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file with comment function enabled.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:

    a. Project name.

b. Date.
c. Designation "PROJECT RECORD DRAWINGS."
d. Name of Architect.
e. Name of Contractor.

1.5 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
5. Note related Change Orders, Record Product Data, and Record Drawings where applicable.

B. Format: Submit record specifications as annotated PDF electronic file.

1.6 RECORD PRODUCT DATA

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.

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

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.

C. Format: Submit Record Product Data as annotated PDF electronic file.

1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.7 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file.

1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.8 MAINTENANCE OF RECORD DOCUMENTS

A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Instruction in operation and maintenance of systems, subsystems, and equipment.
2. Demonstration and training video recordings.

1.2 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

1.3 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.

1. Identification: On each copy, provide an applied label with the following information:

a. Name of Project.
b. Name and address of videographer.
c. Name of Architect.
d. Name of Contractor.
e. Date of video recording.

2. Transcript:

a. Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.

3. At completion of training, submit complete training manual(s) for Owner's use prepared in same PDF file format required for operation and maintenance manuals specified in Section 017823 "Operation and Maintenance Data."

1.4 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.

D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:

1. Inspect and discuss locations and other facilities required for instruction.
2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
3. Review required content of instruction.
4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.5 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.6 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

a. System, subsystem, and equipment descriptions.
b. Performance and design criteria if Contractor is delegated design responsibility.
c. Operating standards.
d. Regulatory requirements.
e. Equipment function.
f. Operating characteristics.
g. Limiting conditions.
h. Performance curves.

2. Documentation: Review the following items in detail:

a. Emergency manuals.
b. Systems and equipment operation manuals.
c. Systems and equipment maintenance manuals.
d. Product maintenance manuals.
e. Project Record Documents.
f. Identification systems.
g. Warranties and bonds.
h. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

a. Instructions on meaning of warnings, trouble indications, and error messages.
b. Instructions on stopping.
c. Shutdown instructions for each type of emergency.
d. Operating instructions for conditions outside of normal operating limits.
e. Sequences for electric or electronic systems.
f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

a. Startup procedures.
b. Equipment or system break-in procedures.
c. Routine and normal operating instructions.
d. Regulation and control procedures.
e. Control sequences.
f. Safety procedures.
g. Instructions on stopping.
h. Normal shutdown instructions.
i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:

a. Alignments.
b. Checking adjustments.
c. Noise and vibration adjustments.
d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

    a. Diagnostic instructions.
    b. Test and inspection procedures.

7. Maintenance: Include the following:

    a. Inspection procedures.
    b. Types of cleaning agents to be used and methods of cleaning.
    c. List of cleaning agents and methods of cleaning detrimental to product.
    d. Procedures for routine cleaning.
    e. Procedures for preventive maintenance.
    f. Procedures for routine maintenance.
    g. Instruction on use of special tools.

8. Repairs: Include the following:

    a. Diagnosis instructions.
    b. Repair instructions.
    c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
    d. Instructions for identifying parts and components.
    e. Review of spare parts needed for operation and maintenance.

1.7 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."

B. Set up instructional equipment at instruction location.

1.8 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

    1. Schedule training with Owner with at least seven days' advance notice.

D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral performance-based test.

F. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017900

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SECTION 031000 - CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Form-facing material for cast-in-place concrete.
2. Shoring, bracing, and anchoring.

B. Related Requirements:
1. Section 321313 "Concrete Paving" for formwork related to concrete pavement and walks.
2. Section 321316 "Decorative Concrete Paving" for formwork related to decorative concrete pavement and walks.

1.3 DEFINITIONS

A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.

B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following:
1. Exposed surface form-facing material.
2. Concealed surface form-facing material.
3. Pan-type forms.
4. Void forms.
5. Insulating concrete forms.
6. Form ties.
7. Waterstops.
8. Form-release agent.

B. Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.
1. For exposed vertical concrete walls, indicate dimensions and form tie locations.
2. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301.

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a. Location of construction joints is subject to approval of the Architect/Engineer.
3. Indicate location of waterstops.
4. Indicate proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.
5. Indicate layout of insulating concrete forms, dimensions, course heights, form types, and details.

C. Samples:
1. For waterstops.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing and inspection agency.

B. Research Reports: For insulating concrete forms indicating compliance with International Code Council Acceptance Criteria AC353.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing and Inspection Agency Qualifications: Provided by Contractor. An independent agency, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Insulating Concrete Forms: Store forms off ground and under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.
a. For architectural concrete specified in Section 033300 "Architectural Concrete," limit deflection of form-facing material, studs, and walers to 0.0025 times their respective clear spans (L/400).

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B. Design, engineer, erect, shore, brace, and maintain insulating concrete forms in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.

2.2 FORM-FACING MATERIALS

A. As-Cast Surface Form-Facing Material:
   1. Provide continuous, true, and smooth concrete surfaces.
   2. Furnish in largest practicable sizes to minimize number of joints.
   3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete, and as follows:
      a. Plywood, metal, or other approved panel materials.
      b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
         1) APA MDO (medium-density overlay); mill-release agent treated and edge sealed.

B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.
   1. Provide lumber dressed on at least two edges and one side for tight fit.

C. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation, with straight end forms.

D. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

2.3 WATERSTOPS

A. Flexible PVC Waterstops: U.S. Army Corps of Engineers CRD-C 572, for embedding in concrete to prevent passage of fluids through joints, with factory fabricated corners, intersections, and directional changes.
   1. Profile: As Indicated.
   2. Dimensions: As Indicated; nontapered.

B. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.

2.4 RELATED MATERIALS

A. Reglets: Fabricate reglets of not less than 0.022-inch-thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

B. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

C. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

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D. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
   1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
   2. Form release agent for form liners shall be acceptable to form liner manufacturer.

E. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

A. Comply with ACI 301.

B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes and Section 033300 "Architectural Concrete".

C. Limit concrete surface irregularities as follows:
   1. Surface Finish-2.0: ACI 117 Class B, 1/4 inch.

D. Construct forms tight enough to prevent loss of concrete mortar.
   1. Minimize joints.
   2. Exposed Concrete: Symmetrically align joints in forms.

E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
   1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
   2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
   3. Install keyways, reglets, recesses, and other accessories, for easy removal.

F. Do not use rust-stained, steel, form-facing material.

G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.
   1. Provide and secure units to support screed strips
   2. Use strike-off templates or compacting-type screeds.

H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.
   1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
   2. Locate temporary openings in forms at inconspicuous locations.

I. Chamfer exterior corners and edges of permanently exposed concrete.

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J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.

K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
1. Determine sizes and locations from trades providing such items.
2. Obtain written approval of Architect/Engineer prior to forming openings not indicated on Drawings.

L. Construction and Movement Joints:
1. Construct joints true to line with faces perpendicular to surface plane of concrete.
2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
3. Place joints perpendicular to main reinforcement.
4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.
   a. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
6. Space vertical joints in walls as indicated on Drawings.
   a. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.

N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.
1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
4. Install dovetail anchor slots in concrete structures, as indicated on Drawings.

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5. Clean embedded items immediately prior to concrete placement.

3.3 INSTALLATION OF WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm.
   1. Install in longest lengths practicable.
   2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
   3. Allow clearance between waterstop and reinforcing steel of not less than 2 times the largest concrete aggregate size specified in Section 033000 "Cast-In-Place Concrete."
   4. Secure waterstops in correct position at 12 inches on center.
   5. Field fabricate joints in accordance with manufacturer's instructions using heat welding.
      a. Miter corners, intersections, and directional changes in waterstops.
      b. Align center bulbs.
   6. Clean waterstops immediately prior to placement of concrete.
   7. Support and protect exposed waterstops during progress of the Work.

B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.
   1. Install in longest lengths practicable.
   2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
   3. Protect exposed waterstops during progress of the Work.

3.4 INSTALLATION OF INSULATING CONCRETE FORMS

A. Comply with ACI 301 and manufacturer's instructions.

B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Install forms in running bond pattern.
   1. Align joints.
   2. Align furring strips.

D. Construct forms tight to prevent loss of concrete mortar.

E. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
   1. Determine sizes and locations from trades providing such items.
   2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.

F. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
   1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
   2. Close temporary ports and openings with tight fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.

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G. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

H. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

I. Shore insulating concrete forms to ensure stability and to resist stressing imposed by construction loads.

3.5 REMOVING AND REUSING FORMS

A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
   1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
   2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work.
   1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
   2. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
   1. Align and secure joints to avoid offsets.
   2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.6 SHORING AND RESHORING INSTALLATION

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
   1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Contractor to engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

B. Inspections:
   1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.

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2. Inspect insulating concrete forms for shape, location, and dimensions of the concrete member being formed.

END OF SECTION 031000

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SECTION 032000 - CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel reinforcement bars.
2. Welded-wire reinforcement.

B. Related Requirements:

1. Section 034100 "Precast Structural Concrete" for reinforcing used in precast structural concrete.
2. Section 034500 "Precast Architectural Concrete" for reinforcing used in precast architectural concrete.
3. Section 321313 "Concrete Paving" for reinforcing related to concrete pavement and walks.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Each type of steel reinforcement.
2. Bar supports.
3. Mechanical splice couplers.

B. Shop Drawings: Comply with ACI SP-066:

1. Include placing drawings that detail fabrication, bending, and placement.
2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.

C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.

1. Location of construction joints is subject to approval of Architect/Engineer.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1. Reinforcement To Be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M.

B. Material Test Reports: For the following, from a qualified testing agency:

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1. Steel Reinforcement:

   a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.

2. Mechanical splice couplers.

C. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, provided by Contractor, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.

1.5 DELIVERY, STORAGE, AND HANDLING

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

2.2 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.

1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

   a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.

C. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.

1. Finish: Plain.

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2.3 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

PART 3 - EXECUTION

3.1 PREPARATION

A. Protection of In-Place Conditions:

1. Do not cut or puncture vapor retarder.
2. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.

B. Accurately position, support, and secure reinforcement against displacement.

1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
2. Do not tack weld crossing reinforcing bars.

C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.

D. Provide concrete coverage in accordance with ACI 318

E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

F. Splices: Lap splices as indicated on Drawings.

1. Bars indicated to be continuous, and all vertical bars to be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
2. Stagger splices in accordance with ACI 318.

3.3 JOINTS

A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect/Engineer.

1. Place joints perpendicular to main reinforcement.
2. Continue reinforcement across construction joints unless otherwise indicated.
3. Do not continue reinforcement through sides of strip placements of floors and slabs.

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B. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length, to prevent concrete bonding to one side of joint.

3.4 INSTALLATION TOLERANCES

A. Comply with ACI 117.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Contractor to engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

B. Inspections:

1. Steel-reinforcement placement.
2. Steel-reinforcement mechanical splice couplers.
3. Steel-reinforcement welding.

END OF SECTION 032000

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SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:

1. Section 031000 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.
2. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.
3. Section 321313 "Concrete Paving" for concrete pavement and walks.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project Site

1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Concrete Subcontractor.
e. Forms and form-removal limitations.
f. Shoring and reshoring procedures.
g. Methods for achieving specified floor and slab flatness and levelness.
h. Floor and slab flatness and levelness measurements.
i. Concrete repair procedures.
j. Concrete protection.
k. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)
l. Protection of field cured field test cylinders.

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1.4 ACTION SUBMITTALS

A. Product Data: For each of the following.

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Blended hydraulic cement.
5. Silica fume.
6. Performance-based hydraulic cement
7. Aggregates.
8. Admixtures:

    a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.

9. Color pigments.
10. Fiber reinforcement.
11. Vapor retarders.
12. Floor and slab treatments.
13. Liquid floor treatments.
14. Curing materials.

    a. Include documentation from color pigment manufacturer, indicating that proposed methods of curing are recommended by color pigment manufacturer.

15. Joint fillers.
16. Repair materials.

B. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.
2. Minimum 28-day compressive strength.
3. Durability exposure class.
4. Maximum w/cm.
5. Calculated equilibrium unit weight, for lightweight concrete.
6. Slump limit.
7. Air content.
8. Nominal maximum aggregate size.
9. Steel-fiber reinforcement content.
10. Synthetic micro-fiber content.
11. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
12. Include manufacturer's certification that permeability-reducing admixture is compatible with mix design.
13. Include certification that dosage rate for permeability-reducing admixture matches dosage rate used in performance compliance test.
14. Intended placement method.

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15. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Shop Drawings:

1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

a. Location of construction joints is subject to approval of the Architect/Engineer.

D. Samples: For and vapor retarder.

E. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:

1. Concrete Class designation.
2. Location within Project.
3. Exposure Class designation.
4. Formed Surface Finish designation and final finish.
5. Final finish for floors.
6. Curing process.
7. Floor treatment if any.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:

1. Installer: Include copies of applicable ACI certificates.
2. Ready-mixed concrete manufacturer.
3. Contractor’s subcontracted Testing agency: Include copies of applicable ACI certificates.

B. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Fiber reinforcement.
4. Curing compounds.
5. Floor and slab treatments.
6. Bonding agents.
7. Adhesives.
8. Vapor retarders.
9. Semirigid joint filler.
10. Joint-filler strips.
11. Repair materials.

C. Material Test Reports: For the following, from a qualified testing agency:

1. Portland cement.
2. Fly ash.
3. Slag cement.

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4. Blended hydraulic cement.
5. Silica fume.
6. Performance-based hydraulic cement.
7. Aggregates.
8. Admixtures:

    a. Permeability-Reducing Admixture: Include independent test reports, indicating compliance with specified requirements, including dosage rate used in test.

D. Research Reports:

1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
2. For sheet vapor retarder/termite barrier, showing compliance with ICC AC380.

E. Preconstruction Test Reports: For each mix design.

F. Field quality-control reports by contractor’s Inspection Agency.

G. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician with experience installing and finishing concrete, incorporating permeability-reducing admixtures.

1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.

B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.

1. Personnel performing laboratory tests to be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor to be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

2. laboratory supervisor to be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

D. Field Quality-Control Testing Agency Qualifications: Contractor provided independent agency, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

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1. Personnel conducting field tests to be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with ACI CPP 610.1 or an equivalent certification program.

2. 610.1 or an equivalent certification program.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.

1. Include the following information in each test report:

a. Admixture dosage rates.
b. Slump.
c. Air content.
d. Seven-day compressive strength.
e. 28-day compressive strength.
f. Permeability.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94/C94M and ACI 301.

1.9 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.

1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

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1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

A. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
3. Obtain aggregate from single source.
4. Obtain each type of admixture from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I/II, gray.
2. Fly Ash: ASTM C618, Class C or F.
3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.

C. Normal-Weight Aggregates: ASTM C33/C33M, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 1 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Air-Entraining Admixture: ASTM C260/C260M.

E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.

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5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

7. Permeability-Reducing Admixture: ASTM C494/C494M, Type S, hydrophilic, permeability-reducing crystalline admixture, capable of reducing water absorption of concrete exposed to hydrostatic pressure (PRAH).
   a. Permeability: No leakage when tested in accordance with U.S. Army Corps of Engineers CRD C48 at a hydraulic pressure of 200 psi for 14 days.

F. Color Pigment: ASTM C979/C979M, synthetic mineral-oxide pigments, color stable, nonfading, and resistant to lime and other alkalis.
   1. Color:As selected by Architect from manufacturer's full range.

G. Water and Water Used to Make Ice: ASTM C94/C94M, potable

2.3 VAPOR RETARDERS

A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A; not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.4 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

   1. Apply to floor surfaces in Rooms 030, 031, 042, 044

2.5 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.

   1. Color:

      a. Ambient Temperature Below 50 deg F: Black.
      b. Ambient Temperature between 50 deg F and 85 deg F: Any color.
      c. Ambient Temperature Above 85 deg F: White.

D. Curing Paper: 8-feet-wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.

E. Water: Potable or complying with ASTM C1602/C1602M.

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F. Clear, Waterborne, Membrane-Forming, Nondissipating Curing Compound: ASTM C309, Type 1, Class B, certified by curing compound manufacturer to not interfere with bonding of floor covering.

2.6 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1752, cork or self-expanding cork.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80] in accordance with ASTM D2240.

C. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:

1. Types I and II, nonload bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

E. Floor Slab Protective Covering: 8-feet- (2438-mm-) wide cellulose fabric.

2.7 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi at 28 days when tested in accordance with ASTM C109/C109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.

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4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109/C109M.

2.8 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.

1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash or Other Pozzolans: 25 percent by mass.
2. Slag Cement: 50 percent by mass.
3. Silica Fume: 10 percent by mass.
4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
5. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.

C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

1. Use water-reducing, high-range water-reducing,or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for garage and shop slabs, and concrete with a w/cm below 0.50.
4. Use permeability-reducing admixture in concrete mixtures in pit walls and floors and where indicated.

D. Color Pigment: Add color pigment to concrete mixture in accordance with manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.9 CONCRETE MIXTURES

A. Class A: Normal-weight concrete used for footings.

1. Exposure Class: ACI 318 F0.
2. Minimum Compressive Strength: 3000 psi at 28 days.
3. Maximum w/cm: 0.50.
4. Slump Limit: 4 inches plus or minus 1 inch.
5. Air Content: None.

B. Class B: Normal-weight concrete used for foundation walls.

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1. Exposure Class: ACI 318 F1.
2. Minimum Compressive Strength: 4000 psi at 28 days.
3. Maximum w/cm: 0.45.
4. Slump Limit: 4 inches, plus or minus 1 inch before addition of admixtures
5. Air Content:

    a. Exposure Class F1: 6.0 percent, plus or minus 1.5 percent at point of delivery.

C. Class C: Normal-weight concrete used for interior slabs-on-ground.

1. Exposure Class: ACI 318 F0
1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Maximum w/cm: 0.45.
3. Slump Limit: 4 inches, plus or minus 1 inch before addition of admixtures
4. Air Content:

    a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.

D. Class D: Normal-weight concrete used for concrete toppings.

1. Exposure Class: ACI 318 F0.
2. Minimum Compressive Strength: 4000 psi at 28 days.
3. Slump Limit: 4 inches, plus or minus 1 inch before addition of admixtures
4. Air Content:

    a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished toppings.

E. Class E: Normal-weight concrete used for interior metal pan stairs and landings:

1. Exposure Class: ACI 318 F0.
2. Minimum Compressive Strength: 4000 psi at 28 days.
1. Maximum w/cm: 0.45.
2. Minimum Cementitious Materials Content: 470 lb/cu. yd. (279 kg/cu. m).
3. Maximum Size Aggregate: 1/2 inch (13 mm).
4. Slump Limit: 3 inches (75 mm), plus 1 inch (25 mm) or minus 2 inches (50 mm).
5. Air Content: 0 percent, plus or minus 0.5 percent at point of delivery.
6. Retarding Admixture: Not allowed.
7. Accelerating Admixture: Not allowed.

F. Class F: Normal-weight concrete used for exterior slabs on grade and aprons.

1. Exposure Class: ACI 318 F3, S0, W1, C2.
2. Minimum Compressive Strength: 5000 psi at 28 days.
3. Maximum w/cm: 0.40.
4. Slump Limit: 4 inches, plus or minus 1 inch before addition of admixtures
5. Air Content:

    a. 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch nominal maximum aggregate size

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b. 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch nominal maximum aggregate size
c. 5.5 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-1/2-inch nominal maximum aggregate size.

6. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

2.10 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94, and furnish batch ticket information.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:

1. Daily access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.

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3.4 INSTALLATION OF VAPOR RETARDER

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.

1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
2. Face laps away from exposed direction of concrete pour.
3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
4. Lap joints 6 inches and seal with manufacturer's recommended tape.
5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
7. Protect vapor retarder during placement of reinforcement and concrete.

    a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.

B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder in accordance with manufacturer's written instructions.

3.5 JOINTS

A. Construct joints true to line, with faces perpendicular to surface plane of concrete.

B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.

1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect/Engineer.
2. Place joints perpendicular to main reinforcement.

    a. Continue reinforcement across construction joints unless otherwise indicated.
    b. Do not continue reinforcement through sides of strip placements of floors and slabs.

3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
6. Space vertical joints in walls as indicated on Drawings. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
7. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:

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1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.

D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints:

1. Install dowel bars and support assemblies at joints where indicated on Drawings.
2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.

1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.

B. Notify Architect/Engineer and testing and inspection agencies 24 hours prior to commencement of concrete placement.

C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.

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1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.

1. If a section cannot be placed continuously, provide construction joints as indicated.
2. Deposit concrete to avoid segregation.
3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.

a. Do not use vibrators to transport concrete inside forms.
b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Do not place concrete floors and slabs in a checkerboard sequence.
2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
3. Maintain reinforcement in position on chairs during concrete placement.
4. Screed slab surfaces with a straightedge and strike off to correct elevations.
5. Level concrete, cut high areas, and fill low areas.
6. Slope surfaces uniformly to drains where required.
7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
8. Do not further disturb slab surfaces before starting finishing operations.

3.7 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 Surface Finish SF-3.0:

a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
b. Remove projections larger than 1/8 inch.
c. Patch tie holes.
d. Surface Tolerance: ACI 117 Class A.
e. Locations: Apply to concrete surfaces exposed to public view.

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B. Rubbed Finish: Apply the following to as cast surface finishes where indicated on Drawings or described here in: Push wall in Room 031 & 045 Detail #4 Sheet A311 and corresponding structural details.

1. Smooth-Rubbed Finish:

a. Perform no later than one day after form removal.
b. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.
c. If sufficient cement paste cannot be drawn from the concrete by the rubbing process, use a grout made from the same cementitious materials used in the in-place concrete.
d. Maintain required patterns or variances as shown on Drawings or to match mockups.

C. Related Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface.
5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
    1) Specified overall values of flatness, F_F 50; and of levelness, F_L 25; with minimum local values of flatness, F_F 40; and of levelness, F_L 17.

C. Broom Finish: Apply a light broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
2. Coordinate required final finish with Architect before application.

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3.9 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 4 inches high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
3. Minimum Compressive Strength: 4000 psi at 28 days.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices.

    a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    b. Cast anchor-bolt insert into bases.
    c. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.

1. Cast-in inserts and accessories, as shown on Drawings.
2. Screed, tamp, and trowel finish concrete surfaces.

3.10 CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h, calculated in accordance with ACI 305.1, before and during finishing operations.

B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:

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1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
3. If forms remain during curing period, moist cure after loosening forms.
4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:

    a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
    b. Continuous Sprinkling: Maintain concrete surface continuously wet.
    c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
    d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
    e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.

        1) Recoat areas subject to heavy rainfall within three hours after initial application.
        2) Maintain continuity of coating and repair damage during curing period.

C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:

1. Begin curing immediately after finishing concrete.
2. Interior Concrete Floors:

    a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:

        1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

            a) Lap edges and ends of absorptive cover not less than 12 inches.
            b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

        2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.

            a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
            b) Cure for not less than seven days.

        3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

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a) Water.
b) Continuous water-fog spray.

b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:

1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

a) Lap edges and ends of absorptive cover not less than 12 inches.
b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.

a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
b) Cure for not less than seven days.

3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

a) Water.
b) Continuous water-fog spray.

c. Floors to Receive Polished Finish: Contractor has option of the following:

1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

a) Lap edges and ends of absorptive cover not less than 12 inches.
b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

a) Water.
b) Continuous water-fog spray.

d. Floors to Receive Chemical Stain:

1) As soon as concrete has sufficient set to permit application without marring concrete surface, install curing paper over entire area of floor.

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2) Install curing paper square to building lines, without wrinkles, and in a single length without end joints.
3) Butt sides of curing paper tight; do not overlap sides of curing paper.
4) Leave curing paper in place for duration of curing period, but not less than 28 days.

e. Floors to Receive Urethane Flooring:

1) As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
2) Rewet absorptive cover, and cover immediately with polyethylene moisture-retaining cover with edges lapped 6 inches and sealed in place.
3) Secure polyethylene moisture-retaining cover in place to prohibit air from circulating under polyethylene moisture-retaining cover.
4) Leave absorptive cover and polyethylene moisture-retaining cover in place for duration of curing period, but not less than 28 days.

f. Floors to Receive Curing and Sealing Compound:

1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
2) Recoat areas subjected to heavy rainfall within three hours after initial application.
3) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.11 TOLERANCES

A. Conform to ACI 117.

3.12 APPLICATION OF LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
2. Do not apply to concrete that is less than 14 days' old.
3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
4. Rinse with water; remove excess material until surface is dry.
5. Apply a second coat in a similar manner if surface is rough or porous.

3.13 JOINT FILLING

A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least six month(s).

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2. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.

D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.14 CONCRETE SURFACE REPAIRS

A. Defective Concrete:

1. Repair and patch defective areas when approved by Architect.
2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.

a. Limit cut depth to 3/4 inch.
b. Make edges of cuts perpendicular to concrete surface.
c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
d. Fill and compact with patching mortar before bonding agent has dried.
e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.

a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
b. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.

a. Correct low and high areas.

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b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.

   a. Finish repaired areas to blend into adjacent concrete.

5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.

   a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
   b. Feather edges to match adjacent floor elevations.

6. Correct other low areas scheduled to remain exposed with repair topping.

   a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
   b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.

   a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
   b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
   c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
   d. Place, compact, and finish to blend with adjacent finished concrete.
   e. Cure in same manner as adjacent concrete.

8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.

   a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
   b. Dampen cleaned concrete surfaces and apply bonding agent.
   c. Place patching mortar before bonding agent has dried.
   d. Compact patching mortar and finish to match adjacent concrete.
   e. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

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F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.15 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.

B. Testing Agency: Contractor to engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

1. Testing agency to be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
2. Testing agency to immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
3. Testing agency to report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.

    a. Test reports to include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:

        1) Project name.
        2) Name of testing agency.
        3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
        4) Name of concrete manufacturer.
        5) Date and time of inspection, sampling, and field testing.
        6) Date and time of concrete placement.
        7) Location in Work of concrete represented by samples.
        8) Date and time sample was obtained.
        9) Truck and batch ticket numbers.
        10) Design compressive strength at 28 days.
        11) Concrete mixture designation, proportions, and materials.
        12) Field test results.
        13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
        14) Type of fracture and compressive break strengths at seven days and 28 days.

C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

D. Inspections:
1. Verification of use of required design mixture.
2. Concrete placement, including conveying and depositing.
3. Curing procedures and maintenance of curing temperature.

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4. Verification of concrete strength before removal of shores and forms from beams and slabs.
5. Batch Plant Inspections: On a random basis, as determined by Architect/Engineer.

E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M to be performed in accordance with the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

    a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143/C143M:

    a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
    b. Perform additional tests when concrete consistency appears to change.

3. Slump Flow: ASTM C1611/C1611M:

    a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
    b. Perform additional tests when concrete consistency appears to change.

4. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete.

    a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

5. Concrete Temperature: ASTM C1064/C1064M:

    a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.

6. Compression Test Specimens: ASTM C31/C31M:

    a. Cast and laboratory cure two sets of two 6-inch by 12-inch or 4-inch by 8-inch cylinder specimens for each composite sample.
    b. Cast, initial cure, and field cure two sets of two standard cylinder specimens for each composite sample.

7. Compressive-Strength Tests: ASTM C39/C39M.

    a. Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days.
    b. Test one set of two field-cured specimens at seven days and one set of two specimens at 28 days.

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c. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor to evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
11. Additional Tests:

    a. Testing and inspecting agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
    b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.

        1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.6.6.3.

12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.16 PROTECTION

A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.
7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

END OF SECTION 033000

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SECTION 034100 - PRECAST STRUCTURAL CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Precast structural concrete.
2. Precast structural concrete with commercial architectural finish.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for concrete topping and placing connection anchors in concrete.
2. Section 051200 "Structural Steel Framing" for furnishing and installing connections attached to structural-steel framing.
3. Section 055000 "Metal Fabrications" for kickers and other miscellaneous steel shapes.
4. Section 071900 "Water Repellents" for water-repellent finish treatments.

1.2 ALLOWANCES

A. Preconstruction, source quality-control, and field quality-control testing are part of testing and inspecting allowance.

1.3 DEFINITIONS

A. Design Reference Sample: Sample of approved precast structural concrete color, finish, and texture, preapproved by Architect.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at project site

B. List of Pre-installation conference attendees: Architect, Owner General Contractor, Precast Supplier, Precast erector if not same as precast supplier

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each precast concrete mixture. Include compressive strength and, if required, water-absorption tests.

C. Shop Drawings:

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1. Include member locations, plans, elevations, dimensions, shapes and sections, openings, support conditions, and types of reinforcement, including special reinforcement.
2. Detail fabrication and installation of precast structural concrete units, including connections at member ends and to adjoining construction.
3. Indicate joints, reveals, drips, chamfers, and extent and location of each surface finish.
4. Indicate separate face and backup mixture locations and thicknesses.
5. Indicate type, size, and length of welded connections by AWS standard symbols.
6. Detail loose and cast-in hardware, lifting and erection inserts, connections, and joints.
7. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
8. Include and locate openings larger than 10 inches. Where additional structural support is required, include header design.
9. Indicate location of each precast structural concrete unit by same identification mark placed on panel.
10. Indicate relationship of precast structural concrete units to adjacent materials.
11. Indicate locations, dimensions, and details of thin-brick units, including corner units and special shapes, and joint treatment.
12. Indicate locations, dimensions, and details of stone facings, anchors, and joint widths.
13. Indicate estimated camber for precast floor slabs with concrete toppings.
14. Indicate shim sizes and grouting sequence.
15. If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.

D. Samples:

1. For each type of finish indicated on exposed surfaces of precast structural concrete units with architectural finish, in sets of three, representative of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches.

    a. Where other faces of precast concrete unit are exposed, include Samples illustrating workmanship, color, and texture of backup concrete as well as facing concrete.

E. Delegated Design Submittal: For precast structural concrete indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Include superimposed loads from wind, seismic, gravity, and as otherwise indicated in the drawings in the design of the precast structural concrete. Design embeds, anchors, and connection details related to connections between the building structural frame and the precast structural concrete.

2. Show precast structural concrete unit types, connections, types of reinforcement, including special reinforcement, and concrete cover on reinforcement. Indicate location, type, magnitude, and direction of loads imposed on the building structural frame from precast structural concrete.

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1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, fabricator, testing agency.

B. Welding certificates.

C. Material Certificates: For the following:

1. Cementitious materials.
2. Reinforcing materials and prestressing tendons.
3. Admixtures.
4. Bearing pads.
5. Insulation.
6. Structural-steel shapes and hollow structural sections.

D. Material Test Reports: For aggregates, by a qualified testing agency.

E. Preconstruction test reports.

F. Source quality-control reports.

G. Field quality-control **and special inspection** reports provided by contractor's agency.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm that assumes responsibility for engineering precast structural concrete units to comply with performance requirements. Responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

1. Designated as a PCI-certified plant as follows:
   a. Group CA, Category C2A.

B. Required Certified Installer Qualifications: A precast concrete erector qualified and designated by PCI's Certificate of Compliance, to erect Category S2 – Complex Structural Systems.

C. Installer Qualifications: An experienced precast concrete erector who has retained a "PCI-Certified Field Auditor" to conduct a field audit of a project installed by erector in Category S2 - Complex Structural Systems and who can produce an Erectors' Post Audit Declaration, according to PCI MNL 127, "PCI Erector's Manual - Standards and Guidelines for the Erection of Precast Concrete Products."

D. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.

E. Quality-Control Standard: For manufacturing procedures, testing requirements, and quality-control recommendations for types of units required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Structural Precast Concrete Products."

F. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

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2. AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."

G. Sample Panels: After sample approval and before fabricating precast structural concrete units with architectural finish produce a minimum of two sample panels approximately 16 sq. ft. in area for review by Architect. Incorporate full-scale details of architectural features, finishes, textures, and transitions in sample panels.

1. Locate panels where indicated or, if not indicated, as directed by Architect.
2. Damage part of an exposed-face surface for each finish, color, and texture, and demonstrate adequacy of repair techniques proposed for repair of surface blemishes.
3. After approval of repair technique, maintain one sample panel at fabricator's plant and one at Project site in an undisturbed condition as a standard for judging the completed Work.
4. Demolish and remove sample panels when directed.
5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.8 COORDINATION

A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction before starting that Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Support units during shipment on nonstaining shock-absorbing material in same position as during storage.

B. Store units with adequate bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.

1. Store units with dunnage across full width of each bearing point unless otherwise indicated.
2. Place adequate dunnage of even thickness between each unit.
3. Place stored units so identification marks are clearly visible, and units can be inspected.

C. Handle and transport units in a manner that avoids excessive stresses that cause cracking or damage.

D. Lift and support units only at designated points indicated on Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Wells Concrete Products

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B. Moline Precast www.moline.com

C. Fabcon, Inc

D. Thomasnet

E. As approved by Architect

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design precast structural concrete units

B. Design Standards: Comply with ACI 318 and with design recommendations in PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of precast structural concrete units indicated.

C. Fire-Resistance Calculations: Where indicated, provide precast structural concrete units whose fire resistance meets prescriptive requirements of authorities having jurisdiction

D. Structural Performance:

1. Precast structural concrete units and connections to withstand design loads indicated within limits and under conditions indicated.
   a. Design precast structural concrete framing system and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live-load deflection, shrinkage and creep of primary building structure, and other building movements. Maintain precast structural concrete deflections within limits of ACI 318.

      1) Thermal Movements: Allow for in-plane thermal movements resulting from annual ambient temperature changes of minus 18 to plus 120 deg F.

2.3 MOLD MATERIALS

A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that provides continuous precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.

1. Mold-Release Agent: Commercially produced form-release agent that does not bond with, stain, or adversely affect precast concrete surfaces and does not impair subsequent surface or joint treatments of precast concrete.

2.4 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A706/A706M, deformed.

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C. Steel Bar Mats: ASTM A184/A184M, fabricated from ASTM A615, Grade 60, ASTM A706, deformed bars, assembled with clips.

D. Plain-Steel Welded Wire Reinforcement: ASTM A185/A185M, fabricated from as-drawn steel wire into flat sheets.

E. Deformed-Steel Welded Wire Reinforcement: ASTM A497/A497M or ASTM A1064/A1064M, flat sheet.

F. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.

2.5 PRESTRESSING TENDONS

A. Pretensioning Strand: ASTM A416, Grade 250 or Grade 270, uncoated, seven-wire, low-relaxation strand.

2.6 CONCRETE MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type III, gray, unless otherwise indicated.

B. Supplementary Cementitious Materials:

1. Fly Ash: ASTM C618, Class C or F, with maximum loss on ignition of 3 percent.
2. Metakaolin: ASTM C618, Class N.
3. Silica Fume: ASTM C1240, with optional chemical and physical requirement.
4. Ground Granulated Blast-Furnace Slag: ASTM C989, Grade 100 or 120.

C. Normal-Weight Aggregates: Except as modified by PCI MNL 116, ASTM C33/C33M, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.

1. Face-Mixture-Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.

    a. Gradation: To match design reference sample.

2. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand compatible with coarse aggregate to match approved finish sample.

D. Coloring Admixture: ASTM C979/C979M, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading. Color: Basis of design Moline Concrete 3012-2 Leather in combination light sandblast and light etch finish per detail 11 sheet A311

E. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 116.

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F. Air-Entraining Admixture: ASTM C260, certified by manufacturer to be compatible with other required admixtures.

G. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.

1. Water-Reducing Admixtures: ASTM C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
4. Water-Reducing and Accelerating Admixture: ASTM C494/C494M, Type E.
5. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
6. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.
7. Plasticizing Admixture: ASTM C1017/C1017M, Type I.
8. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
9. Corrosion-Inhibiting Admixture: ASTM C1582/C1582M.

2.7 STEEL CONNECTION MATERIALS

A. Carbon-Steel Shapes and Plates: ASTM A36/A36M.

B. Carbon-Steel-Headed Studs: ASTM A108, Grade 1010 through 1020, cold finished, AWS D1.1/D1.1M, Type A or B, with arc shields and with minimum mechanical properties of PCI MNL 116.

C. Carbon-Steel Plate: ASTM A283/A283M, Grade C.

D. High-Strength, Low-Alloy Structural Steel: ASTM A572/A572M.

E. Carbon-Steel Structural Tubing: ASTM A500/A500M, Grade B or Grade C.

F. Deformed-Steel Wire or Bar Anchors: ASTM A496/A496M or ASTM A706/A706M.

G. Carbon-Steel Bolts and Studs: ASTM A307, Grade A; carbon-steel, hex-head bolts and studs; carbon-steel nuts, ASTM A563; and flat, unhardened steel washers, ASTM F844.

H. Zinc-Coated Finish: For exterior steel items**,** steel in exterior walls, steel in wash bay walls, and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A123 or ASTM A153.

1. For steel shapes, plates, and tubing to be galvanized, limit silicon content of steel to less than 0.03 percent or to between 0.15 and 0.25 percent or limit sum of silicon and 2.5 times phosphorous content to 0.09 percent.
2. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight and complying with DOD-P-21035B or SSPC-Paint 20.

I. Shop-Primed Finish: Prepare surfaces of nongalvanized-steel items, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3, and shop apply lead- and

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chromate-free, rust-inhibitive primer, complying with performance requirements in MPI 79 according to SSPC-PA 1.

J. Welding Electrodes: Comply with AWS standards.

K. Precast Accessories: Provide clips, hangers, plastic or steel shims, and other accessories required to install precast structural concrete units.

2.8 BEARING PADS

A. Provide one of the following bearing pads for precast structural concrete units as recommended by precast fabricator for application:

1. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, 50 to 70 Shore, Type A durometer hardness, ASTM D2240; minimum tensile strength 2250 psi, ASTM D412.
2. Random-Oriented-Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. 70 to 90 Shore, Type A durometer hardness, ASTM D2240; capable of supporting a compressive stress of 3000 psi with no cracking, splitting, or delaminating in the internal portions of pad. Test one specimen for every 200 pads used in Project.
3. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric bonded to an elastomer; 80 to 100 Shore, Type A durometer hardness, ASTM D2240; complying with AASHTO's "AASHTO LRFD Bridge Design Specifications," Division II, Section 18.10.2; or with MIL-C-882E.
4. Frictionless Pads: PTFE, glass-fiber reinforced, bonded to stainless or mild-steel plate, or random-oriented-fiber-reinforced elastomeric pads; of type required for in-service stress.
5. High-Density Plastic: Multimonomer, nonleaching, plastic strip.

2.9 ACCESSORIES

A. Reglets: Factory cast in panel or field cut in locations shown on drawings where flashing is required along face of precast panels. Coordinate with installation of sheet metal flashing and trim installation.

B. Precast Accessories: Provide clips, hangers, high-density plastic or steel shims, and other accessories required to install structural precast concrete units.

2.10 GROUT MATERIALS

A. Nonmetallic, Nonshrink Grout: Packaged, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107/C1107M, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C1218/C1218M.

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B. Epoxy-Resin Grout: Two-component, mineral-filled epoxy resin; ASTM C881/C881M, of type, grade, and class to suit requirements.

2.11 INSULATED FLAT-WALL PANEL ACCESSORIES

A. Polyisocyanurate Board Insulation: ASTM C591, Type II, 2.5 lb/cu. ft. unfaced, with thickness of 3".

B. Wythe Connectors: Polypropylene pin connectors, Galvanized welded wire trusses, Epoxy-coated carbon-fiber grid manufactured to connect wythes of precast concrete panels.

2.12 CONCRETE MIXTURES

A. Prepare design mixtures for each type of precast concrete required.
   1. Limit use of fly ash to 20 percent replacement of portland cement by weight and ground granulated blast-furnace slag to 20 percent of portland cement by weight; metakaolin and silica fume to 10 percent of portland cement by weight.

B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at precast structural concrete fabricator's option.

C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 116 when tested according to ASTM C1218/C1218M.

D. Normal-Weight Concrete Mixtures: Proportion at fabricator's option by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:

   1. Compressive Strength (28 Days): 5000 psi.
   2. Maximum Water-Cementitious Materials Ratio: 0.45.

E. Water Absorption: For structural precast concrete with an architectural finish, limit water absorption to 6 percent by weight or 14 percent by volume, tested according to ASTM C642, except for boiling requirement.

F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 116.

G. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

H. Concrete Mix Adjustments: Concrete mix design adjustments may be proposed if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

2.13 MOLD FABRICATION

A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing and

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detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.

1. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concrete placement. Coat form liner with form-release agent.

B. Maintain molds to provide completed precast structural concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.

1. Form joints are not permitted on faces of structural precast concrete with an architectural finish that is exposed to view in the finished work.
2. Edge and Corner Treatment: Uniformly chamfered.

2.14 FABRICATION

A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.

1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."

B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing precast structural concrete units to supporting and adjacent construction.

C. Cast-in reglets, slots, holes, and other accessories in precast structural concrete units as indicated on the Contract Drawings.

D. Cast-in openings larger than 10 inches in any dimension. Do not drill or cut openings or prestressing strand without Architect/Engineers's approval.

E. Reinforcement: Comply with recommendations in PCI MNL 116 for fabricating, placing, and supporting reinforcement.

1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcement exceeds limits specified in ASTM A775/A775M, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
3. Place reinforcing steel and prestressing strand to maintain at least 3/4-inch minimum concrete cover. Increase cover requirements for reinforcing steel to 1-1/2 inches when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.

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4. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.

F. Reinforce precast structural concrete units to resist handling, transportation, and erection stresses and specified in-place loads.

G. Prestress tendons for precast structural concrete units by either pretensioning or post-tensioning methods. Comply with PCI MNL 116.

1. Delay detensioning or post-tensioning of precast, prestressed structural concrete units until concrete has reached its indicated minimum design release compressive strength as established by test cylinders cured under same conditions as concrete unit.
2. Detension pretensioned tendons either by gradually releasing tensioning jacks or by heat cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.
3. If concrete has been heat cured, detension while concrete is still warm and moist to avoid dimensional changes that may cause cracking or undesirable stresses.
4. Protect strand ends and anchorages with bituminous, zinc-rich, or epoxy paint to avoid corrosion and possible rust spots.

H. Comply with requirements in PCI MNL 116 and in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.

I. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete units.

J. Thoroughly consolidate placed concrete by vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 116.

K. Comply with PCI MNL 116 procedures for hot- and cold-weather concrete placement.

L. Identify pickup points of precast structural concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast structural concrete unit on a surface that does not show in finished structure.

M. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated heat curing using live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.

N. Discard and replace precast structural concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 116 and meet Architect's approval.

2.15 CASTING INSULATED WALL PANELS

A. Cast, screed, and consolidate wythe supported by mold.

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B. Place insulation boards abutting edges and ends of adjacent boards. Insert wythe connectors through insulation and consolidate concrete around connectors according to connector manufacturer's written instructions.

C. Ensure bottom wythe and insulation layer are not disturbed after bottom wythe reaches initial set.

D. Cast, screed, and consolidate top wythe to meet required finish.

E. Maintain temperature below 150 deg F in bottom concrete wythe.

2.16 FABRICATION TOLERANCES

A. Fabricate precast structural concrete units to shapes, lines, and dimensions indicated so each finished unit complies with PCI MNL 116 product dimension tolerances as well as position tolerances for cast-in items.

2.17 COMMERCIAL FINISHES

A. Grade B Finish: Fill air pockets and holes larger than 1/4 inch in diameter with sand-cement paste matching color of adjacent surfaces. Fill air holes greater than 1/8 inch in width that occur more than once per 2 sq. in. Grind smooth form offsets or fins larger than 1/8 inch. Repair surface blemishes due to holes or dents in molds. Discoloration at form joints is permitted.

2.18 COMMERCIAL ARCHITECTURAL FINISHES

A. Manufacture member faces free of joint marks, grain, and other obvious defects with corners, including false joints, uniform and straight. Finish exposed-face surfaces of precast concrete units to match approved mockups and as follows:

1. Abrasive-Blast Finish: Use abrasive grit, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces.
2. Acid-Etched Finish: Use acid and hot-water solution, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces. Protect hardware, connections, and insulation from acid attach.

2.19 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate precast structural concrete fabricator's quality-control and testing methods.

1. Allow testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with testing agency and provide samples of materials and concrete mixtures as may be requested for additional testing and evaluation.

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B. Testing: Test and inspect precast structural concrete according to PCI MNL 116 requirements and ASTM C1610/C1610M, ASTM C1611/C1611M, ASTM C1621/C1621M, and ASTM C1712/C1712M.

C. Strength of precast structural concrete units is considered deficient if units fail to comply with ACI 318 requirements for concrete strength.

D. If there is evidence that strength of precast concrete units may be deficient or may not comply with ACI 318 requirements, employ a qualified testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C42/C42M.

1. A minimum of three representative cores to be taken from units of suspect strength, from locations directed by Architect/Engineer.
2. Test cores in an air-dry condition or, if units are wet under service conditions, test cores after immersion in water in a wet condition.
3. Strength of concrete for each series of three cores is considered satisfactory if average compressive strength is equal to at least 85 percent of 28-day design compressive strength and no single core is less than 75 percent of 28-day design compressive strength.
4. Report test results in writing on same day that tests are performed, with copies to Architect, Contractor, and precast concrete fabricator. Test reports include the following:

a. Project identification name and number.
b. Date when tests were performed.
c. Name of precast concrete fabricator.
d. Name of concrete testing agency.
e. Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.

E. Patching: If core test results are satisfactory and precast structural concrete units comply with requirements, clean and dampen core holes and solidly fill with same precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.

F. Defective Units: Discard and replace precast structural concrete units that do not comply with requirements, including strength, manufacturing tolerances, and color and texture range. Chipped, spalled, or cracked units may be repaired, subject to Architect's approval. Architect reserves the right to reject precast units that do not match approved samples, sample panels, and mockups. Replace unacceptable units with precast concrete units that comply with requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, bearing surface tolerances, and other conditions affecting performance of the Work.

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B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Do not install precast concrete units until supporting, cast-in-place concrete has attained minimum allowable design compressive strength and until supporting steel or other structure is structurally ready to receive loads from precast concrete units.

3.2 INSTALLATION

A. Install clips, hangers, bearing pads, and other accessories required for connecting precast structural concrete units to supporting members and backup materials.

B. Erect precast structural concrete level, plumb, and square within specified allowable tolerances. Provide temporary structural framing, shoring, and bracing as required to maintain position, stability, and alignment of units until permanent connections are complete.

1. Install temporary steel or plastic spacing shims or bearing pads as precast structural concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
3. Remove projecting lifting devices and use plastic patch caps or sand-cement grout to fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.

C. Connect precast structural concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.

1. Do not permit connections to disrupt continuity of roof flashing.

D. Field cutting of precast units is not permitted without approval of Architect/Engineer.

E. Fasteners: Do not use drilled or powder-actuated fasteners for attaching accessory items to precast, prestressed concrete units.

F. Welding: Comply with applicable requirements in AWS D1.1/D1.1M and AWS D1.4/D1.4M for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.

1. Protect precast structural concrete units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.
2. Clean weld-affected steel surfaces with chipping hammer followed by brushing, and apply a minimum 4.0-mil-thick coat of galvanized repair paint to galvanized surfaces according to ASTM A780/A780M.
3. Visually inspect welds and remove, reweld, or repair incomplete and defective welds.

G. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.

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1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot.
2. For slip-critical connections, use one of the following methods to assure proper bolt pretension:

    a. Turn-of-Nut: According to RCSC's "Specification for Structural Joints Using ASTM A325 or A 490 Bolts."
    b. Calibrated Wrench: According to RCSC's "Specification for Structural Joints Using ASTM A325 or A 490 Bolts."
    c. Twist-off Tension Control Bolt: ASTM F3125/F3125M, Grade 1852.
    d. Direct-Tension Control Bolt: ASTM F3125/F3125M, Grade 1852.

3. For slip-critical connections, use method and inspection procedure approved by Architect and coordinated with inspection agency.

H. Grouting or Dry-Packing Connections and Joints: Grout connections and joints and open spaces at keyways, connections, and joints where required or indicated on Shop Drawings. Retain flowable grout in place until hard enough to support itself. Alternatively, pack spaces with stiff dry-pack grout material, tamping until voids are completely filled.

1. Place grout and finish smooth, level, and plumb with adjacent concrete surfaces.
2. Fill joints completely without seepage to other surfaces.
3. Trowel top of grout joints on roofs smooth and uniform. Finish transitions between different surface levels not steeper than 1 to 12.
4. Place grout end cap or dam in voids at ends of hollow-core slabs.
5. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.
6. Keep grouted joints damp for not less than 24 hours after initial set.

3.3 ERECTION TOLERANCES

A. Erect precast structural concrete units level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 135.

B. Minimize variations between adjacent slab members by jacking, loading, or other method recommended by fabricator and approved by Architect.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:

1. Erection of precast structural concrete members.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Visually inspect field welds and test according to ASTM E165 or to ASTM E709 and ASTM E1444. High-strength bolted connections are subject to inspections.

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D. Testing agency will report test results promptly and in writing to Contractor and Architect.

E. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.

F. Additional testing and inspecting, at Contractor's expense, to be performed to determine compliance of replaced or additional work with specified requirements.

G. Prepare test and inspection reports.

3.5 REPAIRS

A. Repair precast structural concrete units if permitted by Architect/Engineer.

1. Repairs may be permitted if structural adequacy, serviceability, durability, and appearance of units have not been impaired.

B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet.

C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A780/A780M.

D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.

E. Remove and replace damaged precast structural concrete units that cannot be repaired or when repairs do not comply with requirements as determined by Architect.

3.6 CLEANING

A. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.

B. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.

1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's written recommendations. Protect other work from staining or damage due to cleaning operations.
2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION 034100

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SECTION 034500 - PRECAST ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Precast architectural concrete units.
2. Mold materials.
3. Reinforcing materials.
4. Concrete materials.
5. Steel connection materials.
6. Accessories.
7. Grout materials.
8. Clay facing materials.
9. Insulated panel materials.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" site-cast concrete requirements and for installing connection anchors in concrete.
2. Section 051200 "Structural Steel Framing" for furnishing and installing connections attached to structural-steel framing.
3. Section 055000 "Metal Fabrications" for kickers and other miscellaneous steel shapes.

1.2 DEFINITIONS

A. Design Reference Sample: Sample of approved architectural precast concrete color, finish, and texture, preapproved by Architect.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Precast architectural concrete unit design mixtures: Include compressive strength and water-absorption tests for each precast concrete mixture.
2. Mold materials.
3. Concrete materials.
4. Steel connection materials.
5. Accessories.
6. Grout materials.
7. Clay facing materials.
8. Insulated panel materials.

B. Shop Drawings:

1. Detail fabrication and installation of architectural precast concrete units.
2. Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit.
3. Indicate joints, reveals, drips, chamfers, and extent and location of each surface finish.
4. Indicate details at building corners.
5. Indicate separate face and backup mixture locations and thicknesses.
6. Indicate type, size, and length of welded connections by AWS standard symbols. Detail loose and cast-in hardware and connections.
7. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
8. Indicate locations, extent, and treatment of dry joints if two-stage casting is proposed.
9. Include plans and elevations showing unit locations, dimensions, erection sequences, and bracing plans for special conditions.
10. Indicate location of each architectural precast concrete unit by same identification mark placed on panel.
11. Indicate relationship of architectural precast concrete units to adjacent materials.
12. Indicate locations, type, dimensions, and details of facing units, including corner units, special shapes, joint treatment, and anchors.
13. Indicate multiple wythe connection details.
14. Coordinate and indicate openings and inserts required by other trades.
15. If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and indicate modified areas on Shop Drawings. Do not adversely affect the appearance, durability, or strength of units.

C. Samples: Design reference samples for initial verification of design intent, for each type of finish indicated on exposed surfaces of architectural precast concrete units, in sets of three, representative of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches (300 by 300 by 50 mm).

1. When other faces of precast concrete unit are exposed, include Samples illustrating workmanship, color, and texture of backup concrete as well as facing concrete.
2. Samples for each thin-brick unit required, showing full range of color and texture expected. Include Sample showing color and texture of joint treatment.

    a. Grout Samples for Initial Selection: Color charts consisting of actual sections of grout showing manufacturer's full range of colors.

D. Delegated Design Submittals: For architectural precast concrete indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Show governing panel types, connections, types of reinforcement, including special reinforcement, and concrete cover on reinforcement. Indicate location, type, magnitude, and direction of loads imposed on the building structural frame from architectural precast concrete.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Provide locations, setting diagrams, templates, instructions, and directions, as required, for furnishing and installation of loose connection hardware and anchorage items to be embedded in or attached to other construction.

B. Welding certificates.

C. Material Test Reports: For each of the following items, for tests performed by manufacturer.

1. Aggregates.
2. Cementitious materials.
3. Reinforcing materials and prestressing tendons.
4. Admixtures.
5. Bearing pads.
6. Structural-steel shapes and hollow structural sections.
7. Thin-brick units and accessories.
8. Insulation.

D. Qualification Statements: For fabricator.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm that assumes responsibility for engineering architectural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

1. Designated as a PCI-certified plant.

B. Certified Installer Qualifications: A precast concrete erector qualified and designated by PCI's Certificate of Compliance to erect Category S2 (Complex Structural Systems) for load-bearing members.

C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

D. Delegated Design Engineer Qualifications: A professional engineer who is legally qualified to practice in state where Project is located and who is experienced in providing engineering services of the type indicated.

E. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:

1. AWS D1.1/D1.1M.
2. AWS D1.4/D1.4M.
3. AWS D1.6/D1.6M.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver architectural precast concrete units in such quantities and at such times to limit unloading units temporarily on the ground or other rehandling.

B. Support units during shipment on nonstaining shock-absorbing material.

C. Store units with adequate dunnage and bracing, and protect units to prevent contact with soil, prevent staining, and prevent cracking, distortion, warping, or other physical damage.

D. Place stored units so identification marks are clearly visible, and units can be inspected.

E. Handle and transport units in a manner that avoids excessive stresses that cause cracking or damage.

F. Lift and support units only at designated points indicated on Shop Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design architectural precast concrete units.

B. Design Standards: Comply with ACI 318 and design recommendations of PCI MNL 120 applicable to types of architectural precast concrete units indicated.

C. Calculated Fire-Test-Response Characteristics: Provide architectural precast concrete units with fire-resistance rating indicated as calculated in accordance with ACI/TMS 216.1/216.1M) or PCI 124 and acceptable to authorities having jurisdiction.

D. Structural Performance: Provide architectural precast concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:

1. Loads: As indicated.
2. Design precast concrete units and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live-load deflection, shrinkage and creep of primary building structure, and other building movements.
3. Thermal Movements: Provide for in-plane thermal movements resulting from annual ambient temperature changes of 120 deg F (67 deg C).
4. Fire-Resistance Rating: Select material and minimum thicknesses to provide 1-hour fire rating.

E. Source Limitations: Obtain precast architectural concrete units from single fabricator.

2.2 MOLD MATERIALS

A. Molds: Rigid, dimensionally stable, nonabsorptive material, warp and buckle free, that provides continuous and true precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.

B. Form-Release Agent: Commercially produced form-release agent that does not bond with, stain, or adversely affect precast concrete surfaces and does not impair subsequent surface or joint treatments of precast concrete.

C. Surface Retarder: Chemical-set retarder, capable of temporarily delaying final hardening of newly placed concrete mixture to depth of reveal specified.

2.3 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A615/A615M, Grade 60 (Grade 420), deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A706/A706M, deformed.

C. Steel Bar Mats: ASTM A184/A184M, fabricated from ASTM A615/A615M, Grade 60 (Grade 420), deformed bars, assembled with clips.

D. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, fabricated from as-drawn steel wire into flat sheets.

E. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

F. Supports: Suspend reinforcement from back of mold. Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement in place may only be used if they are not visible in the finished face.

2.4 CONCRETE MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type III.

1. For surfaces exposed to view in finished structure, use gray and white cement, of same type, brand, and mill source.

a. Standard gray cement is acceptable for use where not exposed to view.

B. Supplementary Cementitious Materials:

1. Fly Ash: ASTM C618, Class C or F, with maximum loss on ignition of 3 percent.
2. Metakaolin: ASTM C618, Class N.
3. Silica Fume: ASTM C1240, with optional chemical and physical requirement[**, white**].
4. Ground Granulated Blast-Furnace Slag: ASTM C989/C989M, Grade 100 or 120.

C. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C33/C33M, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.

1. Face-Mixture-Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match approved finish sample.

2. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand compatible with coarse aggregate; to match approved finish sample.

D. Coloring Admixture: ASTM C979/C979M, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading..

E. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.

F. Air-Entraining Admixture: ASTM C260/C260M, certified by manufacturer to be compatible with other required admixtures.

G. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.

1. Water-Reducing Admixtures: ASTM C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
4. Water-Reducing and -Accelerating Admixture: ASTM C494/C494M, Type E.
5. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
6. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
7. Plasticizing Admixture: ASTM C1017/C1017M, Type I.
8. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
9. Corrosion-Inhibiting Admixture: ASTM C1582/C1582M.

2.5 STEEL CONNECTION MATERIALS

A. Carbon Steel Shapes and Plates: ASTM A36/A36M.

B. Carbon Steel-Headed Studs: ASTM A108, Grades 1010 through 1020, cold finished, AWS D1.1/D1.1M, Type A or Type B, with arc shields and with minimum mechanical properties of PCI MNL 117, Table 3.2.3.

C. Carbon Steel Plate: ASTM A283/A283M, Grade C.

D. High-Strength, Low-Alloy Structural Steel: ASTM A572/A572M.

E. Carbon Steel Structural Tubing: ASTM A500/A500M, Grade B or Grade C.

F. Wrought Carbon Steel Bars: ASTM A675/A675M, Grade 65 (Grade 450).

G. Deformed-Steel Wire or Bar Anchors: ASTM A1064/A1064M or ASTM A706/A706M.

H. Carbon Steel Bolts and Studs: ASTM A307, Grade A, or ASTM F1554, Grade 36; carbon steel, hex-head bolts and studs; carbon steel nuts, ASTM A563 (ASTM A563M); and flat, unhardened steel washers, ASTM F844.

I. Shop-Primed Finish: Prepare surfaces of nongalvanized-steel items, except those surfaces to be embedded in concrete, in accordance with requirements in SSPC-SP 3, and shop-apply lead- and chromate-free, rust-inhibitive primer, complying with performance requirements in MPI 79 in accordance with SSPC-PA 1.

J. Welding Electrodes: Comply with AWS standards.

2.6 ACCESSORIES

A. Reglets Specified Elsewhere: Specified in Section 076200 "Sheet Metal Flashing and Trim."

B. Precast Accessories: Provide clips, hangers, high-density plastic or steel shims, and other accessories required to install architectural precast concrete units.

2.7 GROUT MATERIALS

A. Sand-Cement Grout: Portland cement, ASTM C150/C150M, Type I, and clean, natural sand, ASTM C144 or ASTM C404. Mix at ratio of 1 part cement to 2-1/2 to 3 parts sand, by volume, with minimum water required for placement and hydration. Water-soluble chloride ion content is to be less than 0.06 percent by weight of cement when tested in accordance with ASTM C1218/C1218M.

B. Nonmetallic, Nonshrink Grout: Packaged, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107/C1107M, Grade A for dry pack and Grades B and C for flowable grout, and of consistency suitable for application within a 30-minute working time. Water-soluble chloride ion content is to be less than 0.06 percent by weight of cement when tested in accordance with ASTM C1218/C1218M.

C. Epoxy-Resin Grout: Two-component, mineral-filled epoxy resin; ASTM C881/C881M, of type, grade, and class to suit requirements.

2.8 CLAY FACING MATERIALS

A. Thin Brick: Not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) thick, and as follows:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Endicott Clay Products Co.
        1) Color: Desert Ironspot Dark

2. Dimensional Tolerances: Plus 0 inch (0 mm) or minus 1/16 inch (1.6 mm) for any dimension 8 inches (203 mm) or less and plus 0 inch (0 mm) or minus 3/32 inch (2.4 mm) for any dimension of more than 8 inches (203 mm).
3. Out-of-Square Tolerance: Plus or minus 1/16 inch (1.6 mm).
4. Warpage Tolerance: Not more than 1/16 inch (1.6 mm) either concave or convex from consistent plane.
5. Variation of Shape from Specified Angle: Plus or minus one degree.
6. Modulus of Rupture: Not less than 250 psi (1.7 MPa) when tested in accordance with ASTM C67/C67M.
7. Tensile Bond Strength: Not less than 150 psi (1.0 MPa) when tested before and after freeze-thaw test in accordance with ASTM E488/E488M as modified: Adhere a steel plate with a welded rod on a single thin-brick face with epoxy for each test.

8. 24-Hour Cold-Water Absorption: Not more than 6 percent when tested in accordance with ASTM C67/C67M.
9. Freeze-Thaw Resistance: No detectable disintegration or separation after 300 cycles when tested in accordance with ASTM C666/C666M, Method A or B.
10. Chemical Resistance: Tested in accordance with ASTM C650 and rated "not affected."
11. Efflorescence: Tested in accordance with ASTM C67/C67M and rated "not effloresced."
12. Back Surface Texture: Scored, combed, wire roughened, ribbed, keybacked, or dovetailed.
13. Face Size: 2-1/4 inches (57 mm) high by 7-5/8 inches (194 mm) long.
14. Special Shapes: Include corners, edge corners, and end edge corners.

B. Sand-Cement Mortar: Portland cement, ASTM C150/C150M, Type I, and clean, natural sand, ASTM C144. Mix at ratio of 1 part cement to 4 parts sand, by volume, with minimum water required for placement.

C. Pointing Grout: Packaged, polymer-modified, sanded grout complying with ANSI A118.7.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Bostik; Arkema.
b. Laticrete International, Inc.
c. MAPEI Corporation.

2. Colors: As selected by Architect from manufacturer's full range.

2.9 INSULATED PANEL MATERIALS

A. Polyisocyanurate Board Insulation: Continuous throughout entire panel, 3” panel with an average R value of 19.69

B. Wythe Connectors: Glass-fiber-reinforced vinylester connectors or Fiberglass trusses manufactured to connect wythes of precast concrete panels.

2.10 CONCRETE MIXTURES

A. Prepare design mixtures for each type of precast concrete required.

1. Use a single design mixture for units with more than one major face or edge exposed.
2. Where only one face of unit is exposed, use either a single design mixture or separate mixtures for face and backup.

B. Limit use of fly ash and ground granulated blast-furnace slag to 20 percent of portland cement by weight; limit metakaolin and silica fume to 10 percent of portland cement by weight.

C. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at architectural precast concrete fabricator's option.

D. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 117 when tested in accordance with ASTM C1218/C1218M.

E. Normal-Weight Concrete Mixtures: Proportion face and backup mixtures by either laboratory trial batch or field test data methods in accordance with ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 5000 psi (34.5 MPa) minimum.
2. Maximum Water-Cementitious Materials Ratio: 0.45.

F. Water Absorption: Six percent by weight or 14 percent by volume, tested in accordance with ASTM C642, except for boiling requirement.

G. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.

H. When included in design mixtures, add other admixtures to concrete mixtures in accordance with manufacturer's written instructions.

2.11 FABRICATION OF MOLDS

A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing and detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.

B. Maintain molds to provide completed architectural precast concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.

1. Form joints are not permitted on faces exposed to view in the finished Project.
2. Edge and Corner Treatment: Uniformly chamfered.

2.12 FABRICATION OF CLAY FACING

A. Place form liner templates accurately to provide grid for thin-brick facings. Provide solid backing and supports to maintain stability of liners while placing thin bricks and during concrete placement.

B. Securely place thin-brick units face down into form liner pockets, and place concrete backing mixture.

C. Completely fill joint cavities between thin-brick units with sand-cement mortar, and place precast concrete backing mixture while sand-cement mortar is still fluid enough to ensure bond.

D. Mix and install pointing grout in accordance with ANSI A108.10. Completely fill joint cavities between thin-brick units with pointing grout, and compress into place without spreading grout onto faces of thin-brick units. Remove excess grout immediately to prevent staining of thin brick.

1. Tool joints to a slightly concaves hape when pointing grout is thumbprint hard.

E. Clean faces and joints of thin-brick facing.

2.13 FABRICATION OF PRECAST ARCHITECTURAL CONCRETE

A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.

1. Weld-headed studs and deformed bar anchors used for anchorage in accordance with AWS D1.1/D1.1M and AWS C5.4.

B. Furnish loose hardware items, including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing architectural precast concrete units to supporting and adjacent construction.

C. Cast-in reglets, slots, holes, and other accessories in architectural precast concrete units, as indicated on the Drawings.

D. Cast-in openings larger than 10 inches (250 mm) in any dimension. Do not drill or cut openings or prestressing strand without Architect's approval.

E. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement.

1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcing exceeds limits specified in ASTM A775/A775M, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
3. Place reinforcing steel and prestressing strands to maintain at least 3/4-inch (19-mm) minimum concrete cover. Increase cover requirements for reinforcing steel to 1-1/2 inches (38 mm) when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
4. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.

F. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses and specified in-place loads.

G. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.

H. Place face mixture to a minimum thickness after consolidation of the greater of 1 inch (25 mm) or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover specified.

I. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete units.

1. Place backup concrete mixture to ensure bond with face-mixture concrete.

J. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 117.

1. Place self-consolidating concrete without vibration in accordance with PCI TR-6. Ensure adequate bond between face and backup concrete, if used.

K. Comply with PCI MNL 117 for hot- and cold-weather concrete placement.

L. Identify pickup points of architectural precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each architectural precast concrete unit on a surface that does not show in finished structure.

M. Cure concrete, in accordance with PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.

N. Discard and replace architectural precast concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs comply with requirements in PCI MNL 117 and Architect's approval.

2.14 FABRICATION OF INSULATED PANELS

A. Cast, screed, and consolidate bottom concrete wythe supported by mold.

B. Place insulation boards abutting edges and ends of adjacent boards. Insert wythe connectors through insulation holes, and consolidate concrete around connectors in accordance with connector manufacturer's written instructions.

C. Ensure bottom wythe and insulation layer are not disturbed after bottom wythe reaches initial set.

D. Cast, screed, and consolidate top wythe to meet required finish.

E. Maintain temperature below 150 deg F (65 deg C) in bottom concrete wythe.

2.15 FABRICATION TOLERANCES

A. Fabricate architectural precast concrete units to shapes, lines, and dimensions indicated so each finished unit complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.

B. Fabricate architectural precast concrete units to shapes, lines, and dimensions indicated so each finished unit complies with the following product tolerances:

1. Overall Height and Width of Units, Measured at the Face Exposed to View: As follows:

    a. 10 ft. (3 m) or under, plus or minus 1/8 inch (3 mm).
    b. 10 to 20 ft. (3 to 6 m), plus 1/8 inch (3 mm), minus 3/16 inch (5 mm).
    c. 20 to 40 ft. (6 to 12 m), plus or minus 1/4 inch (6 mm).
    d. Greater Than 20 ft. (6 m): Each additional 10 ft. (3 m), plus or minus 1/16 inch (1.6 mm).
    e. Greater Than 40 ft. (12 m): Each additional 10 ft. (3 m), plus or minus 1/16 inch (1.6 mm).

2. Overall Height and Width of Units, Measured at the Face Not Exposed to View: As follows:

    a. 10 ft. (3 m) or under, plus or minus 1/4 inch (6 mm).
    b. 10 to 20 ft. (3 to 6 m), plus 1/4 inch (6 mm), minus 3/8 inch (10 mm).
    c. 20 to 40 ft. (6 to 12 m), plus or minus 3/8 inch (10 mm).
    d. Greater Than 20 ft. (6 m): Each additional 10 ft. (3 m), plus or minus 1/8 inch (3 mm).
    e. Greater Than 40 ft. (12 m): Each additional 10 ft. (3 m), plus or minus 1/8 inch (3 mm).

3. Total Thickness or Flange Thickness: Exposed edge plus or minus 1/8 inch (3 mm); Unexposed edge plus 1/4 inch (6 mm), minus 1/8 inch (3 mm).
4. Rib Thickness: Plus or minus 1/8 inch (3 mm).
5. Rib to Edge of Flange: Plus or minus 1/8 inch (3 mm).
6. Distance between Ribs: Plus or minus 1/8 inch (3 mm).
7. Variation from Square or Designated Skew (Difference in Length of the Two Diagonal Measurements): Plus or minus 1/8 inch/72 inches (3 mm/1830 mm) or 1/2 inch (13 mm) total, whichever is greater.
8. Length and Width of Block-outs and Openings within One Unit: Plus or minus 1/8 inch (3 mm) for maximum opening dimensions less than 10 ft. (3 m) and plus 3/16 inch (5 mm), minus 1/8 inch (3 mm) for maximum opening dimensions greater than 10 ft. (3 m).
9. Location and Dimension of Block-outs Hidden from View and Used for HVAC and Utility Penetrations: Plus or minus 3/4 inch (19 mm).
10. Dimensions of Haunches: Plus or minus 1/4 inch (6 mm).
11. Haunch Bearing Surface Deviation from Specified Plane: Plus or minus 1/8 inch (3 mm).
12. Difference in Relative Position of Adjacent Haunch Bearing Surfaces from Specified Relative Position: Plus or minus 1/4 inch (6 mm).
13. Bowing: Plus or minus L/360, maximum 1 inch (25 mm).
14. Local Smoothness: 1/4 inch/10 ft. (6 mm/3 m).
15. Warping: 1/16 inch/12 inches (1.6 mm/300 mm) from nearest adjacent corner.

C. Position Tolerances: For cast-in items measured from datum line location, as indicated on Shop Drawings.

1. Weld Plates: Plus or minus 1 inch (25 mm).
2. Tipping and Flushness of Plates: Plus or minus 1/4 inch (6 mm).
3. Dimensions of Architectural Features and Rustications: Plus or minus 1/8 inch (3 mm).
4. Inserts: Plus or minus 1/2 inch (13 mm).
5. Handling Devices: Plus or minus 3 inches (75 mm).
6. Reinforcing Steel and Welded-Wire Reinforcement: Plus or minus 1/4 inch (6 mm) where position has structural implications or affects concrete cover; otherwise, plus or minus 1/2 inch (13 mm).
7. Reinforcing Steel Extending out of Member: Plus or minus 1/2 inch (13 mm).
8. Prestressing Reinforcement: Plus or minus 1/4 inch (6 mm), perpendicular to panel; plus or minus 1 inch (25 mm), parallel to panel.
9. Location of Rustication Joints: Plus or minus 1/8 inch (3 mm).
10. Location of Opening within Panel: Plus or minus 1/4 inch (6 mm).
11. Location of Flashing Reglets: Plus or minus 1/4 inch (6 mm).
12. Location of Flashing Reglets at Edge of Panel: Plus or minus 1/8 inch (3 mm).
13. Reglets for Glazing Gaskets: Plus or minus 1/8 inch (3 mm).
14. Electrical Outlets, Hose Bibs: Plus or minus 1/2 inch (13 mm).
15. Location of Bearing Surface from End of Member: Plus or minus 1/4 inch (6 mm).
16. Allowable Rotation of Plate, Channel Inserts, and Electrical Boxes: Two-degree rotation or 1/4 inch (6 mm) maximum, measured at perimeter of insert.
17. Position of Sleeve: Plus or minus 1/2 inch (13 mm).
18. Location of Window-Washer Track or Buttons: Plus or minus 1/8 inch (3 mm).

D. Thin-Brick-Faced Architectural Precast Concrete Units: Restrict the following misalignments to 2 percent of number of thin bricks in a unit.

1. Alignment of Mortar Joints:

   a. Jog in Alignment: 1/8 inch (3 mm).
   b. Alignment with Panel Centerline: Plus or minus 1/8 inch (3 mm).

2. Variation in Width of Exposed Mortar Joints: Plus or minus 1/8 inch (3 mm).
3. Tipping of Individual Thin Bricks from Panel Plane of Exposed Thin-Brick Surface: Plus 0 inch (0 mm); minus 1/4 inch (6 mm) less than or equal to depth of form liner joint.
4. Exposed Thin-Brick Surface Parallel to Primary Control Surface of Panel: Plus 1/4 inch (6 mm); minus 1/8 inch (3 mm).
5. Individual Thin-Brick Step in Face from Panel Plane of Exposed Thin-Brick Surface: Plus 0 inch (0 mm); minus 1/4 inch (6 mm) less than or equal to depth of form liner joint.

2.16 FINISHES

A. Exposed faces to be free of joint marks, grain, and other obvious defects. Corners, including false joints to be uniform, straight, and sharp. Finish exposed-face surfaces of architectural precast concrete units to match approved sample panels and as follows:

1. PCI's "Architectural Precast Concrete - Color and Texture Selection Guide," of plate numbers indicated.

a. PCI Product Number: 278, Buff/Tan, Acid Etched

2. Exposed-Aggregate Finish: Use chemical retarding agents applied to concrete forms and washing and brushing procedures to expose aggregate and surrounding matrix surfaces after form removal.
3. Abrasive-Blast Finish: Use abrasive grit, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces.
4. Acid-Etched Finish: Use acid and hot-water solution, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces. Protect hardware, connections, and insulation from acid attach.
5. Thin-Brick or Terra Cotta Facing: See "Clay Facing Materials" Article.

B. Finish exposed backsurfaces of architectural precast concrete units with smooth, steel-trowel finish.

C. Finish unexposed surfaces of architectural precast concrete units with as-cast finish.

2.17 SOURCE QUALITY CONTROL

A. Quality-Control Testing: Test and inspect precast concrete in accordance with PCI MNL 117 requirements. If using self-consolidating concrete, also test and inspect in accordance with PCI TR-6, ASTM C1610/C1610M, ASTM C1611/C1611M, ASTM C1621/C1621M, and ASTM C1712.

B. Strength of precast concrete units is considered deficient if units fail to comply with ACI 318 requirements for concrete strength.

C. Testing: Fabricator will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength in accordance with ASTM C42/C42M and ACI 318.

1. A minimum of three representative cores to be taken from units of suspect strength, from locations directed by Architect.
2. Test cores in an air-dry condition.
3. Strength of concrete for each series of three cores is considered satisfactory if average compressive strength is equal to at least 85 percent of 28-day design compressive strength and no single core is less than 75 percent of 28-day design compressive strength.
4. Report test results in writing on same day that tests are performed, with copies to Architect, Contractor, and precast concrete fabricator. Test reports include the following:

a. Project identification name and number.
b. Date when tests were performed.
c. Name of precast concrete fabricator.
d. Name of concrete testing agency.
e. Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.

D. Patching: If core test results are satisfactory and precast concrete units comply with requirements, clean and dampen core holes and solidly fill with precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.

E. Defective Units: Discard and replace recast architectural concrete units that do not comply with acceptability requirements in PCI MNL 117, including concrete strength, manufacturing tolerances, and color and texture range. Chipped, spalled, or cracked units may be repaired, subject to Architect's approval. Architect reserves the right to reject precast units that do not match approved samples, sample panels, and mockups. Replace unacceptable units with precast concrete units that comply with requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, bearing surface tolerances, and other conditions affecting performance of the Work.

B. Do not install precast concrete units until supporting cast-in-place concrete has attained minimum allowable design compressive strength and supporting steel or other structure is structurally ready to receive loads from precast concrete units.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF PRECAST ARCHITECTURAL CONCRETE UNITS

A. Install clips, hangers, bearing pads, and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.

B. Erect architectural precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment of units until permanent connections are completed.

1. Install temporary steel or plastic spacing shims as precast concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
3. Remove projecting lifting devices and grout fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
4. Unless otherwise indicated, maintain uniform joint widths of 3/4 inch (19 mm).

C. Connect architectural precast concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.

1. Do not permit connections to disrupt continuity of roof flashing.

D. Welding: Comply with applicable requirements in AWS D1.1/D1.1M and AWS D1.4/D1.4M for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.

1. Protect architectural precast concrete units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.
2. Welds not specified to be continuous fillet welds use no less than the minimum fillet as specified by AWS.
3. Clean weld-affected metal surfaces with chipping hammer followed by brushing, and re-priming damaged painted surfaces.
4. Visually inspect welds and remove, reweld, or repair incomplete and defective welds.

E. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.

1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot.
2. For slip-critical connections, use one of the following methods to assure proper bolt pretension:

    a. Turn-of-Nut: In accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
    b. Calibrated Wrench: In accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
    c. Twist-off Tension Control Bolt: ASTM F3125/F3125M, Grade 1852.
    d. Direct-Tension Control Bolt: ASTM F3125/F3125M, Grade 1852.

3. For slip-critical connections, use method and inspection procedure approved by Architect and coordinated with inspection agency.

F. Grouting or Dry Packing Connections and Joints: Grout connections where required or indicated. Retain flowable grout in place until hard enough to support itself. Alternatively, pack spaces with stiff dry pack grout material, tamping until voids are completely filled. Place grout and finish smooth, level, and plumb with adjacent concrete surfaces. Promptly remove grout material from exposed surfaces before it affects finishes or hardens. Keep grouted joints damp for not less than 24 hours after initial set.

3.3 ERECTION TOLERANCES

A. Erect architectural precast concrete units level, plumb, square, and in alignment, without exceeding the following noncumulative erection tolerances:

1. Plan Location from Building Grid Datum: Plus or minus 1/2 inch (13 mm).
2. Plan Location from Centerline of Steel: Plus or minus 1/2 inch (13 mm).
3. Top Elevation from Nominal Top Elevation: As follows:

    a. Exposed Individual Panel: Plus or minus 1/4 inch (6 mm).
    b. Nonexposed Individual Panel: Plus or minus 1/2 inch (13 mm).

4. Support Elevation from Nominal Support Elevation: As follows:

a. Maximum Low: 1/2 inch (13 mm).
b. Maximum High: 1/4 inch (6 mm).

5. Maximum Plumb Variation over the Lesser of Height of Structure or 100 ft. (30 m): 1 inch (25 mm).
6. Plumb in Any 10 ft. (3 m) of Unit Height: 1/4 inch (6 mm), additionally a maximum of 1/2 inch (13 mm) over total height of the unit.
7. Maximum Jog in Alignment of Matching Edges: 1/4 inch (6 mm).

a. Exposed Panel Relative to Adjacent Panel: 1/4 inch (6 mm).
b. Nonexposed Panel Relative to Adjacent Panel: 1/2 inch (13 mm).

8. Joint Width (Governs over Joint Taper): Plus or minus 3/16 inch (5 mm) for joints 10 ft. (3 m) or less in length, plus or minus 1/4 inch (6 mm) for joints over 10 ft. (3 m) in length.
9. Maximum Joint Taper: Plus or minus 3/16 inch (5 mm) for joints 10 ft. (3 m) or less in length; plus or minus 1/4 inch (6 mm) for joints over 10 ft. (3 m) in length.
10. Joint Taper in 10 ft. (3 m): 1/4 inch (6 mm).
11. Maximum Jog in Alignment of Matching Faces: 1/4 inch (6 mm).
12. Differential Bowing or Camber, as Erected, between Adjacent Members of Same Design: 1/4 inch (6 mm).
13. Opening Height between Spandrels: Plus or minus 1/4 inch (6 mm).

3.4 REPAIR

A. Repair architectural precast concrete units if permitted by Architect. Architect reserves the right to reject repaired units that do not comply with requirements.

B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 ft. (6 m).

C. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.

D. Remove and replace damaged architectural precast concrete units when repairs do not comply with requirements.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. Erection of loadbearing precast concrete members.
2. Visually inspect field welds and test in accordance with ASTM E165/E165M or to ASTM E709 and ASTM E1444/E1444M.
3. High-strength bolted connections are subject to inspections.

C. Prepare test and inspection reports.

D. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, to be performed to determine compliance of replaced or additional work with specified requirements.

3.6 CLEANING

A. Clean surfaces of precast concrete units exposed to view.

B. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.

C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.

1. Perform cleaning procedures, if necessary, in accordance with precast concrete fabricator's recommendations. Protect other work from staining or damage due to cleaning operations.
2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION 034500

SECTION 042200 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Mortar and grout.
3. Steel reinforcing bars.
4. Masonry-joint reinforcement.
5. Miscellaneous masonry accessories.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.

1.2 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315.
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Material Certificates: For each type and size of the following:

1. Masonry units.

a. Include data on material properties.

b. For masonry units, include data and calculations establishing average net-area compressive strength of units.

2. Integral water repellant used in CMUs.
3. Cementitious materials. Include name of manufacturer, brand name, and type.
4. Mortar admixtures.
5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
6. Grout mixes. Include description of type and proportions of ingredients.
7. Reinforcing bars.
8. Joint reinforcement.
9. Anchors, ties, and metal accessories.

C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
2. Include test reports, in accordance with ASTM C1019, for grout mixes required to comply with compressive strength requirement.

D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined in accordance with TMS 602/ACI 530.1/ASCE 6.

E. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified in accordance with ASTM C1093 for testing indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches (600 mm) down both sides of walls, and hold cover securely in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 PERFORMANCE REQUIREMENTS

A. Provide unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) in accordance with TMS 602/ACI 530.1/ASCE 6.

2.3 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6 except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work and will be within 20 feet (6 m) vertically and horizontally of a walking surface.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

1. Where fire-resistance-rated construction is indicated, units are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.4 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide bullnose units for outside corners unless otherwise indicated.

B. CMUs: ASTM C90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi (14.8 MPa).
2. Density Classification: Normal weight.
3. Size (Width): Manufactured to dimensions 3/8 inch (10 mm) less-than-nominal dimensions.

2.5 MASONRY LINTELS

A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.6 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

1. Alkali content is not more than 0.1 percent when tested in accordance with ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Masonry Cement: ASTM C91/C91M.

D. Aggregate for Mortar: ASTM C144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

E. Aggregate for Grout: ASTM C404.

F. Water: Potable.

2.7 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60 (Grade 420).

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Heckmann Building Products, Inc.
b. Hohmann & Barnard, Inc.
c. Wire-Bond.

C. Masonry-Joint Reinforcement, General: Ladder type complying with ASTM A951/A951M.

1. Interior Walls: Mill- or Hot-dip galvanized carbon steel.
2. Spacing of Cross Rods: Not more than 16 inches (407 mm) o.c.
3. Provide in lengths of not less than 10 feet (3 m).

2.8 TIES AND ANCHORS

A. General: Ties and anchors extend at least 1-1/2 inches (38 mm) into masonry but with at least a 5/8-inch (16-mm) cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Mill-Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A641/A641M, Class 1 coating.
2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A153/A153M, Class B-2 coating.
3. Stainless Steel Wire: ASTM A580/A580M, Type 304.
4. Galvanized-Steel Sheet: ASTM A653/A653M, Commercial Steel, G60 (Z180) zinc coating.
5. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.
6. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.
7. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
8. Corrugated-Metal Ties: Not allowed.

C. Partition Top Anchors: 0.105-inch- (2.66-mm-) thick metal plate with a 3/8-inch- (9.5-mm-) diameter metal rod 6 inches (152 mm) long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.

2.9 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 or PVC, complying with ASTM D2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).

2.10 MASONRY-CELL FILL

A. Loose-Fill Insulation: Perlite complying with ASTM C549, Type II (surface treated for water repellency and limited moisture absorption) or Type IV (surface treated for water repellency and to limit dust generation).

B. Lightweight-Aggregate Fill: ASTM C331/C331M.

2.11 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime, masonry cement or mortar cement mortar unless otherwise indicated.
3. For exterior masonry, use portland cement-lime, masonry cement or mortar cement mortar.
4. For reinforced masonry, use portland cement-lime, masonry cement or mortar cement mortar.
5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.

1. For masonry below grade or in contact with earth, use Type S.
2. For reinforced masonry, use Type S.
3. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.
4. For interior nonload-bearing partitions, Type O may be used instead of Type N.

D. Grout for Unit Masonry: Comply with ASTM C476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa).
3. Provide grout with a slump of 8 to 11 inches (200 to 280 mm) as measured in accordance with ASTM C143/C143M.

E. Epoxy Pointing Mortar: Mix epoxy pointing mortar to comply with mortar manufacturer's written instructions.

1. Application: Use epoxy pointing mortar for exposed mortar joints with pre-faced CMUs.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Verify that substrates are free of substances that would impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Build chases and recesses to accommodate items specified in this and other Sections.

B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2-inch (12-mm) maximum.

2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2-inch (12-mm) maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm).

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm).

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches (100 mm). Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

I. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.
2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch (13-mm) clearance between end of anchor rod and end of tube. Space anchors 48 inches (1200 mm) o.c. unless otherwise indicated.
3. Wedge nonload-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078443 "Joint Firestopping."

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.

B. Lay solid CMUs with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Rake out mortar joints at pre-faced CMUs to a uniform depth of 1/4 inch (6 mm) and point with epoxy mortar to comply with epoxy-mortar manufacturer's written instructions.

D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

E. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

F. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.

3.6 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).

1. Space reinforcement not more than 16 inches (406 mm) o.c.
2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:

1. Provide an open space not less than 1/2 inch (13 mm) wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches (610 mm) o.c. vertically and 36 inches (915 mm) o.c. horizontally.

3.8 CONTROL AND EXPANSION JOINTS

A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry using one of the following methods:

1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
2. Install preformed control-joint gaskets designed to fit standard sash block.
3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.
4. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.

3.9 LINTELS

A. Provide masonry lintels where shown and where openings of more than 12 inches (305 mm) for brick-size units and 24 inches (610 mm) for block-size units are shown without structural steel or other supporting lintels.

B. Provide minimum bearing of 8 inches (200 mm) at each jamb unless otherwise indicated.

3.10 REINFORCED UNIT MASONRY

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

3.11 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements is done at Contractor's expense.

3.12 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

3.13 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Crush masonry waste to less than 4 inches (100 mm) in each dimension.
2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
3. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.

C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042200

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SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural-steel materials.
2. Shrinkage-resistant grout.
3. Prefabricated building columns.
4. Shear stud connectors.

B. Related Requirements:

1. Section 053100 "Steel Decking" for field installation of shear stud connectors through deck.
2. Section 055000 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame, miscellaneous steel fabrications and other steel items not defined as structural steel.

1.2 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site

1.5 ACTION SUBMITTALS

A. Product Data:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.

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3. Shear stud connectors.
4. Anchor rods.
5. Threaded rods.
6. Forged-steel hardware.
7. Slide bearings.
8. Prefabricated building columns.
9. Shop primer.
10. Galvanized-steel primer.
11. Etching cleaner.
12. Galvanized repair paint.
13. Shrinkage-resistant grout.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
5. Identify members not to be shop primed.

C. Delegated Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads and where the Erector or Fabricator proposes alternate connection details to facilitate construction, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, fabricator, shop-painting applicators, professional engineer, testing agency.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural-steel materials, including chemical and physical properties.

E. Product Test Reports: For the following:

1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
2. Shear stud connectors.

F. Survey of existing conditions.

G. Source quality-control reports.

H. Field quality-control reports.

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1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE

B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with applicable provisions of the following specifications and documents:

1. ANSI/AISC 303.
2. ANSI/AISC 360.
3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

B. Connection Design Information:

1. Option 1: Connection designs have been completed and connections indicated on the Drawings.

2. Option 3 and 3A: Where alternate connection details are proposed by Fabricator or Erector, design connections in accordance with ANSI/AISC 303 by fabricator's qualified professional engineer. Member reinforcement at connections is indicated on Drawings.

a. Use Load and Resistance Factor Design; data are given at factored-load level.

C. Moment Connections: Type FR, fully restrained.

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D. Construction: Combined system of moment frame and shear walls.

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A992, Grade 50.

B. Channels, Angles: ASTM A36.

C. Plate and Bar: ASTM A36.

D. Cold-Formed Hollow Structural Sections: ASTM A500**, Grade C** structural tubing.

E. Steel Pipe: ASTM A53, Type E or Type S, Grade B.

1. Weight Class: Standard.
2. Finish: Black except where indicated to be galvanized.

F. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

B. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers in Wash Bay: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

1. Finish: Hot-dip or mechanically deposited zinc coating.

2.4 RODS

A. Headed Anchor Rods: ASTM F1554, Grade 36, straight.

1. Nuts: ASTM A563 heavy-hex carbon steel.
2. Plate Washers: ASTM A36/A36M carbon steel.
3. Washers: ASTM F436, Type 1, hardened carbon steel.
4. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.

2.5 PRIMER

A. Steel Primer:
1. Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

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2.6 SHRINKAGE-RESISTANT GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.7 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.

1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with **SSPC-SP 2.**

F. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural-steel frame. Straighten as required to provide uniform, square, and true members in completed wall framing. Build up welded framing, weld exposed joints continuously, and grind smooth.

G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.8 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.

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1. Joint Type:
   a. Shear Tab Connection: Snug tightened.
   b. Flange Moment Connection: Slip critical.

2.9 GALVANIZING

A. Hot-Dip Galvanized Finish: In the Wash Bay and Elsewhere as Indicated, apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.

2.10 SHOP PRIMING

A. Shop prime steel surfaces, except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Surfaces of high-strength bolted, slip-critical connections.
4. Galvanized surfaces

B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:

1. SSPC-SP 2.

C. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.11 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform shop tests and inspections.

1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
2. Bolted Connections: Inspect shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

   a. Liquid Penetrant Inspection: ASTM E165/E165M.
   b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
   c. Ultrasonic Inspection: ASTM E164.
   d. Radiographic Inspection: ASTM E94/E94M.

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4. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.

B. Baseplates, Bearing Plates, and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting.

C. Maintain erection tolerances of structural steel within ANSI/AISC 303.

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.

E. Splice members only where indicated.

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F. Do not use thermal cutting during erection.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.

1. Joint Type:
   a. Shear Tab Connection: Snug tightened.
   b. Flange Moment Connection: Slip critical.

B. Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

3.5 REPAIR

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.

B. Touchup Painting:

1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

   a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

3.6 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

1. Bolted Connections: Inspect bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."

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2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.

    a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

        1) Liquid Penetrant Inspection: ASTM E165/E165M.
        2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
        3) Ultrasonic Inspection: ASTM E164.
        4) Radiographic Inspection: ASTM E94/E94M.

END OF SECTION 051200

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SECTION 052100 - STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. K-series steel joists.
2. LH-series long-span steel joists.
3. Steel joist accessories.

B. Related Requirements:

1. Section 034100 "Precast Structural Concrete" for installing bearing plates in precast concrete.
2. Section 051200 "Structural Steel Framing" for field-welded shear connectors.

1.2 DEFINITIONS

A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."

B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of joist, accessory, and product.

B. Shop Drawings:

1. Include layout, designation, number, type, location, and spacing of joists.
2. Include joining and anchorage details; bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
3. Indicate locations and details of bearing plates to be embedded in other construction.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer, professional engineer.

B. Welding certificates.

C. Manufacturer certificates.

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D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

E. Mill Certificates: For each type of bolt.

F. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

G. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications"

1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.

B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

1.7 SEQUENCING

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated on Drawings.

1. Use ASD; data are given Service Load level.
2. Design special joists to withstand design loads with live-load deflections no greater than the following:
   a. Roof Joists: Vertical deflection of 1/240 of the span.

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2.2 STEEL JOISTS

A. K-Series Steel Joist: Manufactured steel joists of type indicated according to "Standard Specification for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.

1. Joist Type: K-series steel joists.
2. Provide holes in chord members for connecting and securing other construction to joists.
3. Camber joists according to SJI's "Specifications."
4. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches (1:48).

B. Long-Span Steel Joist: Manufactured steel joists according to "Standard Specification for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as indicated on Drawings.
1. Provide holes in chord members for connecting and securing other construction to joists.
2. Camber long-span steel joists according to SJI's "Specifications."
3. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches (1:48).

2.3 PRIMERS

A. Primer:

1. SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15, except for steel joists installed in the wash bay requiring galvanizing.

2.4 GALVANIZING

A. Hot-Dip Galvanized Finish: In the Wash Bay and Elsewhere as Indicated, apply zinc coating by the hot-dip process to steel joists in accordance with ASTM A123/A123M.

2.5 STEEL JOIST ACCESSORIES

A. Bridging:

1. Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.

B. Steel bearing plates with integral anchorages are specified in Section 055000 "Metal Fabrications."

C. Welding Electrodes: Comply with AWS standards.

D. Galvanizing Repair Paint: ASTM A780.

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E. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.6 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.

B. Do not prime paint joists and accessories located in the Wash Bay to receive galvanized coating.

C. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications", joist manufacturer's written instructions, and requirements in this Section.

1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.
3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.

C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. Bolt joists to supporting steel framework using carbon-steel bolts.

E. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

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3.3 REPAIRS

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

B. Touchup Painting:

1. Immediately after installation, clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.

a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
b. Apply a compatible primer of same type as primer used on adjacent surfaces.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Visually inspect field welds according to AWS D1.1/D1.1M.

C. Visually inspect bolted connections.

D. Prepare test and inspection reports.

END OF SECTION 052100

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SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof deck.
2. Acoustical roof deck.
3. Noncomposite form deck.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
2. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Roof deck.
2. Acoustical roof deck.
3. Noncomposite form deck.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Test and Evaluation Reports:

1. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

a. Power-actuated mechanical fasteners.
b. Acoustical roof deck.

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2. Research Reports: For steel deck, from ICC-ES showing compliance with the building code.

D. Field Quality-Control Submittals:

1. Field quality-control reports.

E. Qualification Statements: For welding personnel and testing agency.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with SDI QA/QC and the following welding codes:

1. AWS D1.1/D1.1M.
2. AWS D1.3/D1.3M.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store products in accordance with SDI MOC3. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck in accordance with AISI S100.

2.2 ROOF DECK

A. Fabrication of Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with SDI RD and with the following:

1. Prime-Painted Steel Sheet: ASTM A1008, Structural Steel (SS), Grade 33 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.

a. Color: Gray.

2. Galvanized-Steel Sheet (Wash Bay): ASTM A653, Structural Steel (SS), Grade 33 minimum, top and bottom surfaces G90 zinc coated.
3. Deck Profile: Type WR, wide rib.
4. Profile Depth: As Indicated.

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5. Design Uncoated-Steel Thickness: As indicated.
6. Span Condition: Triple span or more.
7. Side Laps: Overlapped.

2.3 ACOUSTICAL ROOF DECK

A. Fabrication of Acoustical Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with SDI RD and with the following:

1. Prime-Painted Steel Sheet: ASTM A1008, Structural Steel (SS), Grade 33 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.

    a. Color: Gray.

2. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33 minimum, G60 zinc coating.
3. Deck Profile: Type WR, wide rib.
4. Profile Depth: As indicated.
5. Design Uncoated-Steel Thickness: As indicated.
6. Span Condition: Triple span or more.
7. Side Laps: Overlapped.
8. Acoustical Perforations: Deck units with manufacturer's standard perforated vertical webs.
9. Acoustical Performance: NRC 0.65, tested in accordance with ASTM C423.

2.4 NONCOMPOSITE FORM DECK

A. Fabrication of Noncomposite Form Deck: Fabricate ribbed-steel sheet noncomposite deck panels used as a form to comply with SDI NC, with the minimum section properties indicated, and with the following:

1. Prime-Painted Steel Sheet: ASTM A1008/A1008M, Structural Steel (SS), Grade 33 minimum, with top and underside surface shop primed with manufacturer's standard baked-on, rust-inhibitive primer.

    a. Color: Gray.

2. Profile Depth: As indicated on Plans or Shop Drawings.
3. Design Uncoated-Steel Thickness: As indicated on Plans or Shop Drawings.
4. Span Condition: Simple span.
5. Side Laps: Overlapped.

2.5 ACCESSORIES

A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

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C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi , not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI standards for overhang and slab depth.

G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

H. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

I. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight.

J. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories in accordance with SDI C, SDI NC, and SDI RD, as applicable; manufacturer's written instructions; and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

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F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install in accordance with deck manufacturer's written instructions.

3.3 INSTALLATION OF ROOF DECK

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:

1. Weld Diameter: as indicated.
2. Weld Spacing: as indicated.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-third of the span or 20 inches, and as follows:

1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: Lapped 2 inches minimum.

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld or mechanically fasten flanges to top of deck. Space welds or mechanical fasteners not more than 12 inches apart with at least one weld or fastener at each corner.

1. Install reinforcing channels or zees in ribs to span between supports and weld or mechanically fasten.

E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels in accordance with deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive in accordance with manufacturer's written instructions to ensure complete closure.

G. Sound-Absorbing Insulation: Installation into topside ribs of deck as specified

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3.4 INSTALLATION OF FLOOR DECK

A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:

1. Weld Diameter: 5/8 inch, nominal.
2. Weld Spacing:

a. Weld edge ribs of panels at each support. Space additional welds an average of 16 inches apart, but not more than 18 inches apart.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 36 inches, and as follows:

1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: Lapped or butted at Contractor's option.

D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure in accordance with SDI recommendations unless otherwise indicated.

E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, in accordance with SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.5 REPAIR

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint in accordance with ASTM A780 and manufacturer's written instructions.

B. Repair Painting:

1. Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
2. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

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1. Special inspections and qualification of welding special inspectors for cold-formed steel floor and roof deck in accordance with quality-assurance inspection requirements of SDI QA/QC.

    a. Field welds will be subject to inspection.

2. Steel decking will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 053100

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SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Load-bearing wall framing.
2. Exterior non-load-bearing wall framing.
3. Interior non-load-bearing wall framing.
4. Roof rafter framing.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for miscellaneous steel shapes, masonry shelf angles, and connections used with cold-formed metal framing.
2. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies, with height limitations.
3. Section 092216 "Non-Structural Metal Framing" for standard, interior non-load-bearing, metal-stud framing, with height limitations and ceiling-suspension assemblies.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site

1. Architect, General Contractor, Owner, Partition Installer, Insulator, Electrician.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Cold-formed steel framing materials.
2. Load-bearing wall framing.
3. Exterior non-load-bearing wall framing.
4. Interior non-load-bearing wall framing.
5. Vertical deflection clips.
6. Single deflection track.
7. Double deflection track.
8. Drift clips.
9. Floor joist framing.
10. Roof-rafter framing.
11. Ceiling joist framing.
12. Soffit framing.
13. Post-installed anchors.
14. Power-actuated anchors.
15. Sill sealer gasket.

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16. Sill sealer gasket/termite barrier.

B. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

C. Delegated Design Submittal: For cold-formed steel framing.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Product Certificates: For each type of code-compliance certification for studs and tracks.

D. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.

1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Vertical deflection clips.
6. Horizontal drift deflection clips
7. Miscellaneous structural clips and accessories.

E. Research Reports:

1. For nonstandard cold-formed steel framing post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.
2. For sill sealer gasket/termite barrier, showing compliance with ICC-ES AC380.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

C. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Steel Framing Industry Association.

D. Welding Qualifications: Qualify procedures and personnel according to the following:

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1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect and store cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling as required in AISI S202.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.

B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated on Drawings.
2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:

    a. Exterior Load-Bearing Wall Framing: Horizontal deflection of 1/360 of the wall height.
    b. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/360 of the wall height.
    c. Interior Non-Load-Bearing Framing: Horizontal deflection of 1/360 of the wall height under a horizontal load of 5 lbf/sq. ft.
    d. Roof Rafter Framing: Vertical deflection of 1/360 of the horizontally projected span for live loads.

3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:

    a. Upward and downward movement of L/240.

5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing complies with AISI S100 and AISI S200 and ASTM C955, Section 8.

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2.2 COLD-FORMED STEEL FRAMING MATERIALS

A. Framing Members, General: Comply with **AISI S200 and ASTM C955, Section 8** for conditions indicated.

B. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:

1. Grade: As required by structural performance.
2. Coating: G60.

C. Steel Sheet for Vertical Deflection/Drift Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: As required by structural performance.
2. Coating: G60.

2.3 LOAD-BEARING WALL FRAMING

A. Steel Studs supporting roof framing at Main (South) Office Entry Alcove and West Entrance Alcove: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch.
2. Flange Width: 1-5/8 inches.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch.
2. Flange Width: 1-1/2 inches or as required for structural performance.

C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, unpunched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch.
2. Flange Width: 1-5/8 inches.

D. Steel Single- or Double-L Headers: Manufacturer's standard L-shapes used to form header beams, of web depths indicated, and as follows:

1. Minimum Base-Metal Thickness: 0.0538 inch.
2. Top Flange Width: 1-1/2 inches.

2.4 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428.

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2. Flange Width: 1-5/8.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428.
2. Flange Width: 1-1/2 inches.

C. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

1. Minimum Base-Metal Thickness: 0.0428.
2. Flange Width: 1 inch plus the design gap for one-story structures.

D. Bypass Framing Clips: Manufacturer's standard bypass clips, capable of supporting wall stud through positive mechanical attachment to stud web and structure.

2.5 INTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch.
2. Flange Width: 1-3/8 inches.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch.
2. Flange Width: 1-1/4 inches.

C. Vertical Deflection Clips, Interior: Manufacturer's standard head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch.
2. Flange Width: 1 inch plus the design gap for one-story structures.

2.6 ROOF-RAFTER FRAMING

A. Steel Rafters: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:

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1. Minimum Base-Metal Thickness: 0.0966 inch.
2. Flange Width: 2-1/2 inches, minimum.

2.7 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers and knee braces.
9. Joist hangers and end closures.
10. Hole-reinforcing plates.
11. Backer plates.

2.8 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.

B. Anchor Bolts: ASTM F1554, Grade 36, threaded carbon-steel hex-headed bolts, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A153/A153M, Class C.

C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.

1. Uses: Securing cold-formed steel framing to structure.
2. Type: Torque-controlled expansion anchor or adhesive anchor.
3. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.

D. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

E. Welding Electrodes: Comply with AWS standards.

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2.9 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A780.

B. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C1107/C1107M, and with a fluid consistency and 30-minute working time.

C. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.

D. Sill Sealer Gasket: Closed-cell neoprene foam, 1/4 inch (6 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

E. Sill Sealer Gasket/Termite Barrier: Minimum 68-mil (1.7-mm) nominal thickness, self-adhering sheet consisting of 64 mils (1.6 mm) of rubberized asphalt laminated on one side to a 4-mil-(0.10-mm-) thick, polyethylene-film reinforcement, and with release liner on adhesive side[; formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction].
   1. Physical Properties:
      a. Peel Adhesion: 17.0 lb/in of width when tested in accordance with ASTM D412.
      b. Low-Temperature Flexibility: Pass at minus 25 deg F when tested in accordance with ASTM D146/D146M.
      c. Water Vapor Permeance: 0.05 perm maximum when tested in accordance with ASTM E96/E96M, Method B.
      d. Resistance to Termite Penetration: Comply with ICC-ES AC380.

2.10 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

   1. Fabricate framing assemblies using jigs or templates.
   2. Cut framing members by sawing or shearing; do not torch cut.
   3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
      a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
      b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.
   4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

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B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.

C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, conditions, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.

B. Install sill sealer gasket at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

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1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

    a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

H. Install insulation, specified in Section 072100 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.4 INSTALLATION OF LOAD-BEARING WALL FRAMING

A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:

1. Anchor Spacing: As shown on Shop Drawings.

B. Squarely seat studs against top and bottom tracks, with gap not exceeding 1/8 inch between the end of wall-framing member and the web of track.

1. Fasten both flanges of studs to top and bottom tracks.
2. Space studs as follows:

    a. Stud Spacing: 16 inches.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.

D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.

E. Align floor and roof framing over studs according to AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads.

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F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure.

G. Install headers over wall openings wider than stud spacing. Locate headers above openings. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.

1. Frame wall openings with not less than a double stud at each jamb of frame. Fasten jamb members together to uniformly distribute loads.
2. Install tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.

H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.

1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

I. Install horizontal bridging in stud system, spaced vertically as indicated on Shop Drawings. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of two screws into each flange of the clip angle for framing members up to 6 inches deep.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of 1-1/2 by 0.0329 inch and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges, and secure solid blocking to stud webs or flanges.
3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

J. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 INSTALLATION OF EXTERIOR NONLOADBEARING WALL FRAMING

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: 16 inches.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

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D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.
2. Connect vertical deflection clips to bypassing studs and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of 1-1/2 by 0.0329 inches and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 18 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.

1. Install solid blocking at centers indicated on Shop Drawings.

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.6 INSTALLATION OF INTERIOR NONLOADBEARING WALL FRAMING

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: 16 inches.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.
2. Connect vertical deflection clips to studs and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.

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2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 18 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.

1. Install solid blocking at centers indicated on Shop Drawings.

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.7 INSTALLATION OF RAFTER FRAMING

A. Where rafters bear over bearing walls or ledgers, install perimeter track sized to match rafters. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.

B. Where rafters are inset between structural members, connected with hangers, install the hangers to the structural steel frame using the hanger type, fastening type, and spacings indicated on Shop Drawings.

C. Install rafters bearing on supporting frame or hangers, level, straight, and plumb; adjust to final position, brace, and reinforce. Where rafters bear over bearing walls or ledgers, fasten rafters to both flanges of track.

1. Install rafters over supporting frame with a minimum end bearing of 1-1/2 inches.
2. Reinforce ends and bearing points of rafters with web stiffeners, end clips, hangers, steel clip angles, or steel-stud sections.

D. Space rafters not more than 2 inches from abutting walls, and as follows:

1. Rafter Spacing: As indicated on Drawings.

E. Frame openings with built-up headers, consisting of rafter and track or another combination of connected rafters if indicated.

F. Install bridging at intervals indicated on Shop Drawings and as necessary for connecting exterior wall bracing. Fasten bridging at each rafter intersection as follows:

1. Rafter-Track Solid Bridging: Rafter-track solid blocking of width and thickness indicated, secured to rafter webs. Required at exterior wall bracing locations.
2. Combination Bridging: Combination of flat, taut, steel sheet straps 1-12/ by 0.0329 inches and rafter-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of rafters and secure solid blocking to rafter webs.

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G. Install miscellaneous rafter framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable rafter-framing assembly.

3.8 INSTALLATION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.

3.9 REPAIR

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

3.10 FIELD QUALITY CONTROL

A. Inspection: Engage a qualified independent inspecting agency to perform field inspections and prepare test reports.

B. Field and shop welds will be subject to inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Cold-formed steel framing will be considered defective if it does not pass inspections.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.11 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

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SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Miscellaneous framing and supports.
2. Shelf angles.
3. Metal ships' ladders.
4. Metal floor plate.
5. Structural-steel door frames.
6. Miscellaneous steel trim.
7. Metal bollards.
8. Loose bearing and leveling plates.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.
3. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

C. Related Requirements:

1. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
2. Section 051200 "Structural Steel Framing" for steel framing, supports, elevator machine beams, hoist beams, divider beams, door frames, and other steel items attached to the structural-steel framing.
3. Section 077200 "Roof Accessories" for manufactured metal roof walkways and metal roof stairs.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

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1.3 ACTION SUBMITTALS

A. Product Data:

1. Nonslip aggregates and nonslip-aggregate surface finishes.
2. Fasteners.
3. Shop primers.
4. Shrinkage-resisting grout.
5. Metal ships' ladders.
6. Metal bollards.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:

1. Miscellaneous framing and supports for applications where framing and supports are not specified in other Sections.
2. Shelf angles.
3. Metal ships' ladders.
4. Metal floor plate and supports.
5. Structural-steel door frames.
6. Miscellaneous steel trim including steel edgings.
7. Metal bollards.
8. Loose steel lintels.

C. Delegated Design Submittals: For Ships ladders, if applicable, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

C. Research Reports: For post-installed anchors.

D. Delegated design engineer qualifications.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

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1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design Ships ladders as required by the AHJ

B. Structural Performance of Aluminum Ships Ladders: Ladders, including landings, are to withstand the effects of loads and stresses within limits and under conditions specified in ANSI/ASC A14.3.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.

D. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.

E. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.

F. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.

1. Size of Channels: 1-5/8 by 1-5/8 inches.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless steel fasteners for fastening aluminum, stainless steel.

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B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.

C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, heavy-hex carbon-steel nuts; and where indicated, flat washers.

D. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593; with hex nuts, ASTM F594; and, where indicated, flat washers; Alloy Group 1.

E. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

F. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.

G. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.

H. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

2.4 MISCELLANEOUS MATERIALS

A. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.

B. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

C. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

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F. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

G. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3000 psi.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. 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.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with 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 no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

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2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts for units installed after concrete is placed.

C. Galvanize miscellaneous framing and supports where indicated and where installed in the Wash Bay area.

D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.7 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.

1. Provide mitered and welded units at corners.
2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.

B. Galvanize and prime shelf angles located in exterior walls.

C. Prime shelf angles located in exterior walls with zinc-rich primer.

2.8 METAL LADDERS

A. General:

2.9 METAL SHIPS' LADDERS

A. Provide metal ships' ladders where indicated. Fabricate of open-type construction with channel or plate stringers and pipe and tube railings unless otherwise indicated. Provide brackets and fittings for installation.

1. Treads are not to be less than 5 inches exclusive of nosing or less than 8-1/2 inches including the nosing, and riser height is not to be more than 9-1/2 inches.
2. Fabricate ships' ladders including railings from aluminum.
3. Fabricate treads and platforms from pressure-locked aluminum bar grating. Limit openings in gratings to no more than 3/4 inch in least dimension.
4. Fabricate treads and platforms from rolled-aluminum-alloy tread plate.
5. Comply with applicable railing requirements in Section 055213 "Pipe and Tube Railings."

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2.10 METAL FLOOR PLATE

A. Fabricate from rolled-steel floor plate of thickness indicated below:

1. Thickness: As indicated.

B. Provide grating sections where indicated, fabricated from welded or pressure-locked steel bar grating. Limit openings in gratings to no more than 3/4 inch in least dimension.

C. Provide steel angle supports as indicated.

D. Include steel angle stiffeners, and fixed and removable sections as indicated.

2.11 STRUCTURAL-STEEL DOOR FRAMES

A. Fabricate structural-steel door frames from steel shapes, plates, and bars of size and to dimensions indicated, fully welded together, with 5/8-by-1-1/2-inch steel channel stops, unless otherwise indicated. Plug-weld built-up members and continuously weld exposed joints. Secure removable stops to frame with countersunk machine screws, uniformly spaced at not more than 10 inches o.c. Reinforce frames and drill and tap as necessary to accept finish hardware.

1. Provide with integrally welded steel strap anchors for securing door frames into adjoining concrete or masonry.

B. Extend bottom of frames to floor elevation indicated with steel angle clips welded to frames for anchoring frame to floor with expansion shields and bolts.

C. Galvanize and prime exterior steel frames.

D. Prime steel frames with zinc-rich primer.

2.12 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize and prime exterior miscellaneous steel trim.

D. Prime miscellaneous steel trim with zinc-rich primer.

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2.13 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 80 steel pipe.
   1. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
   2. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.

B. Fabricate sleeves for bollard anchorage from steel or stainless steel pipe with 1/4-inch-thick, steel or stainless steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches deep and 3/4 inch larger than OD of bollard.

C. Prime steel bollards with zinc-rich primer.

2.14 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize bearing and leveling plates.

C. Prime plates with zinc-rich primer.

2.15 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than 8 inches unless otherwise indicated.

C. Galvanize and prime loose steel lintels located in exterior walls.

D. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.16 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.17 GENERAL FINISH REQUIREMENTS

A. Finish metal fabrications after assembly.

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B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.18 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
4. Other Steel Items: SSPC-SP 3, "Power Tool Cleaning."
5. Galvanized-Steel Items: SSPC-SP 16, "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals."

E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. 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 surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

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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 no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:

1. Cast Aluminum: Heavy coat of bituminous paint.
2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for [ceiling-hung toilet partitions] [operable partitions] [overhead doors] [and] [overhead grilles] securely to, and rigidly brace from, building structure.

C. Anchor shelf angles securely to existing construction with [expansion anchors] [anchor bolts] [through bolts].

D. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

E. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installation of Bearing and Leveling Plates" Article.

1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3 INSTALLATION OF SHELF ANGLES

A. Install shelf angles as required to keep masonry level, at correct elevation, and flush with vertical plane.

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3.4 INSTALLATION OF METAL SHIPS' LADDERS

A. Secure top and bottom of ships' ladders to construction to comply with manufacturer's written instructions.

3.5 INSTALLATION OF METAL FLOOR PLATE

A. Install metal floor plates flush with finished surface. Adjust as required to avoid lippage that could present a tripping hazard.

3.6 INSTALLATION OF STRUCTURAL-STEEL DOOR FRAMES

A. Fasten structural steel door frames to the floor slab by means of angle clips and expansion bolts. Anchor door jambs to adjacent construction in accordance with shop drawing details.

3.7 INSTALLATION OF MISCELLANEOUS STEEL TRIM

A. Anchor to concrete construction to comply with manufacturer's written instructions.

3.8 INSTALLATION OF METAL BOLLARDS

A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.

B. Anchor bollards in place with concrete footings as indicated. Center and align bollards in holes 3 inches (75 mm) above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

C. Fill bollards solidly with concrete, mounding top surface to shed water. Comply with vinyl bollard cover manufacturer instructions for topping off bollards. Do not hinder correct installation of the vinyl bollard cover.

3.9 INSTALLATION OF LOOSE BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.10 REPAIRS

A. Touchup Painting:

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1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

    a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055000

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SECTION 055113 - METAL PAN STAIRS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preassembled steel stairs with concrete-filled treads.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for metal stairs.

1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry.
2. Deliver such items to Project site in time for installation.

C. Coordinate locations of hanger rods and struts with other work so they do not encroach on required stair width and are within fire-resistance-rated stair enclosure.

1.3 ACTION SUBMITTALS

A. Product Data: For metal pan stairs and the following:

1. Prefilled metal-pan-stair treads.
2. Shop primer products.
3. Grout.

B. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other work.
2. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
3. Include plan at each level.

C. Delegated Design Submittal: For stairs,, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer's experience with providing delegated design engineering services of the kind indicated, including documentation that engineer is licensed in the jurisdiction in which Project is located.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

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

1. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers.
2. Protect steel members and packaged materials from corrosion and deterioration.
3. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures.

    a. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design stairs,, including attachment to building construction.

B. Structural Performance of Stairs: Metal stairs withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing and guard loads in addition to loads specified above.

5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch (6.4 mm), whichever is less.

2.2 METALS

A. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Uncoated, Cold-Rolled Steel Sheet: ASTM A1008/A1008M, either commercial steel, Type B, or structural steel, Grade 25 (Grade 170), unless another grade is required by design loads; exposed.

D. Uncoated, Hot-Rolled Steel Sheet: ASTM A1011/A1011M, either commercial steel, Type B, or structural steel, Grade 30 (Grade 205), unless another grade is required by design loads.

E. Galvanized Steel Sheet: ASTM A653/A653M, G90 (Z275) coating, either commercial steel, Type B, or structural steel, Grade 33 (Grade 230), unless another grade is required by design loads.

2.3 FASTENERS

A. General: Provide zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls.

1. Select fasteners for type, grade, and class required.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.

C. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.

D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

2.4 MISCELLANEOUS MATERIALS

A. Welding Electrodes: Comply with AWS requirements.

B. Shop Primers: Provide primers that comply with Section 099123 "Interior Painting."

C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

D. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish system indicated.

E. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

G. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout; recommended by manufacturer for interior use; noncorrosive and nonstaining; mixed with water to consistency suitable for application and a 30-minute working time.

H. Prefilled Concrete Treads:

1. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with minimum 28-day compressive strength of 3000 psi (20 MPa) and maximum aggregate size of 1/2 inch (13 mm) unless otherwise indicated.
2. Nonslip-Aggregate Concrete Finish: Factory-packaged abrasive aggregate made from fused, aluminum-oxide grits or crushed emery; rustproof and nonglazing; unaffected by freezing, moisture, or cleaning materials.
3. Plain Steel Welded-Wire Reinforcement: ASTM A1064/A10645M, 6 by 6 inches (152 by 152 mm), W1.4 by W1.4, unless otherwise indicated on Drawings.

4. Reinforcement Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening welded-wire reinforcement in place.

a. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete.

I. For galvanized reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.5 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.

B. Assemble stairs in shop to greatest extent possible.

1. Disassemble units only as necessary for shipping and handling limitations.
2. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately.

1. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated.
2. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work with accurate angles and surfaces and straight edges.

F. Weld connections to comply with 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. Weld exposed corners and seams continuously unless otherwise indicated.
5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 - No evidence of welded joint.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.

1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
2. Locate joints where least conspicuous.
3. Fabricate joints that will be exposed to weather in a manner to exclude water.
4. Provide weep holes where water may accumulate internally.

2.6 FABRICATION OF STEEL-FRAMED STAIRS

A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Commercial Class, unless more stringent requirements are indicated.

B. Stair Framing:

1. Stringers: Fabricate of steel plates, steel channels, or steel rectangular tubes.

a. Stringer Size: As required to comply with "Performance Requirements" Article.
b. Provide closures for exposed ends of channel and rectangular tube stringers.
c. Finish: Shop primed.

2. Platforms: Construct of steel plate, steel channel, or steel rectangular tube headers and miscellaneous framing members as required to comply with "Performance Requirements" Article.

a. Provide closures for exposed ends of channel and rectangular tube framing.

b. Finish: Shop primed.

3. Weld stringers to headers; weld framing members to stringers and headers.

4. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.067 inch (1.7 mm).

1. Steel Sheet, Uncoated: Cold-rolled steel sheet.
2. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
3. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
4. Shape metal pans to include nosing integral with riser.
5. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.

2.7 FINISHES

A. Finish metal stairs after assembly.

B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
2. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

C. Preparation for Shop Priming: Prepare uncoated, ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."

D. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify elevations of floors, bearing surfaces and locations of bearing plates, and other embedments for compliance with requirements.

1. For wall-mounted railings, verify locations of concealed reinforcement within gypsum board and plaster assemblies.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF METAL PAN STAIRS

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.

1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

1. Grouted Baseplates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates.

a. Clean bottom surface of plates.
b. Set plates for structural members on wedges, shims, or setting nuts.
c. Tighten anchor bolts after supported members have been positioned and plumbed.
d. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
e. Promptly pack grout solidly between bearing surfaces and plates so no voids remain.

1) Neatly finish exposed surfaces; protect grout and allow to cure.
2) Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

E. Fit exposed connections accurately together to form hairline joints.

1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
2. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
3. Comply with requirements for welding in "Fabrication, General" Article.

F. Place and finish concrete fill for treads and platforms to comply with Section 033000 "Cast-in-Place Concrete."

3.3 REPAIR

A. Touchup Painting:

1. 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 for touching up shop-painted surfaces.

    a. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099123 "Interior Painting."

B. Repair of Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055113

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel railings.

B. Related Requirements:

1. Section 055113 "Metal Pan Stairs" for steel tube railings associated with metal pan stairs.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Manufacturer's product lines of mechanically connected railings.
2. Fasteners.
3. Post-installed anchors.
4. Handrail brackets.
5. Nonshrink, nonmetallic grout.
6. Anchoring cement.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Verification: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters, including finish.
2. Fittings and brackets.

D. Delegated Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Mill Certificates: Signed by manufacturers of stainless steel products, certifying that products furnished comply with requirements.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

E. Product Test Reports: For tests on railings performed by a qualified testing agency, in accordance with ASTM E894 and ASTM E935.

F. Research Reports: For post-installed anchors, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces of railings from damage by applying a strippable, temporary protective covering before shipping.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
b. Infill load and other loads need not be assumed to act concurrently.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1-1/2-inch (38-mm) clearance from inside face of handrail to finished wall surface.

2.3 STEEL RAILINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Wagner Companies (The); R&B Wagner, Inc.

B. Source Limitations: Obtain each type of railing from single source from single manufacturer.

C. Pipe: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

D. Plates, Shapes, and Bars: ASTM A36/A36M.

E. Cast Iron Fittings: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

2.4 FASTENERS

A. Fastener Materials:

1. Ungalvanized-Steel Railing Components: Plated steel fasteners complying with ASTM F1941/F1941M, Class Fe/Zn 5 for zinc coating.
2. Hot-Dip Galvanized Railing Components: Type 304 stainless steel or hot-dip zinc-coated steel fasteners complying with ASTM A153/A153M or ASTM F2329/F2329M for zinc coating.
3. Finish exposed fasteners to match appearance, including color and texture, of railings.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.

D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

2.5 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099123 "Interior Painting."

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

D. Intermediate Coats and Topcoats: Provide products that comply with Section 099123 "Interior Painting."

E. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout, complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

F. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

2.6 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.

1. Clearly mark units for reassembly and coordinated installation.
2. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately.

1. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated.
2. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that are exposed to weather in a manner that excludes water.

1. Provide weep holes where water may accumulate.
2. Locate weep holes in inconspicuous locations.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 welds; ornamental quality with no evidence of a welded joint.

I. Form changes in direction as follows:

1. As detailed.
2. By bending or by inserting prefabricated elbow fittings.
3. By bending to smallest radius that will not result in distortion of railing member.

J. Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

K. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.

L. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work.

1. Fabricate anchorage devices capable of withstanding loads imposed by railings.
2. Coordinate anchorage devices with supporting structure.

O. For removable railing posts, fabricate slip-fit sockets from stainless steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height.

1. Provide socket covers designed and fabricated to resist being dislodged.
2. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.

P. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.7 STEEL AND IRON FINISHES

A. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, hot-dip galvanize anchors to be embedded in exterior concrete or masonry.

B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3.

C. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1 for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Shop prime uncoated railings with primers specified in Section 099123 "Interior Painting" unless zinc-rich primer is indicated.

D. High-Performance Coating: Apply epoxy intermediate and polyurethane topcoats to prime-coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1 for shop painting. Apply at spreading rates recommended by coating manufacturer.

1. Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Perform cutting, drilling, and fitting required for installing railings.

1. Fit exposed connections together to form tight, hairline joints.
2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
4. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
5. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3.5 m).

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

1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

C. Adjust railings before anchoring to ensure matching alignment at abutting joints.

D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article, whether welding is performed in the shop or in the field.

3.3 ANCHORING POSTS

A. Anchor posts to metal surfaces with flanges, angle type, or floor type, as required by conditions, connected to posts and to metal supporting members as follows:

1. For steel railings, weld flanges to post and bolt to metal supporting surfaces.

B. Install removable railing sections, where indicated, in slip-fit stainless steel sockets cast in concrete.

3.4 ATTACHING RAILINGS

A. Anchor railing ends to concrete and masonry with flanges connected to railing ends and anchored to wall construction with anchors and bolts.

B. Attach handrails to walls with wall brackets, except where end flanges are used. Provide brackets with 1-1/2-inch (38-mm) clearance from inside face of handrail and finished wall surface.

1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.

2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

C. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.

3.5 REPAIR

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099123 "Interior Painting."

3.6 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period, so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 055213

SECTION 057000 - DECORATIVE METAL

PART 1 - GENERAL

1.1 SUMMARY

A. Provide Emblems and letters as detailed.

B. Furnish the following for other section to install including, but not limited to:

1. Metal fabrication accessories including, but not limited to rough hardware.

1.2 REFERENCES

A. ASTM:
1. A167 – Stainless and Heat Resisting Chromium Nickel Steel Plate, Sheet

B. International Building Code

C. NAAMM – Metal Finishes Manual

1.3 DEFINITIONS

A. Metal Fabrications: Items made from iron and steel shapes, plates, bars, strips, tubes, pipes, castings not part of structural steel or other metal systems specified elsewhere.

1.4 SUBMITTALS

A. Refer to Section 013300

B. Product Data: Data for products used, including paint products and grout.

C. Shop Drawings:

1. Detail fabrication, erection of each metal fabrication indicated. Include plans, elevations, sections, details of metal fabrications, their connections. Show anchorage and accessory items.
2. Provide templates for anchors, bolts specified for installation under other sections.

D. Samples: 2 sets, representative of materials, finished products as requested by Architect.

E. Welder Certificated: Signed by Contractor certifying that welders comply with specified requirements

F. Qualification Data: For firms and persons specified, to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Architects and Owners, and other information specified.

1.5 QUALITY ASSURANCE

A. Single Source Responsibility: Provide ornamental metal units furnished by 1 manufacturer as coordinated assemblies.

B. Qualifications:

1. Fabricator: 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.
2. Installer: Arrange for installation of metal fabrications specified in this section by same firm that fabricated them.
3. Welding Processes and Welding Operators: Qualify in accordance with AWS D1.1, D1.2, and D1.3. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with specified requirements, acceptable manufacturers and products are:

1. Metal Fabricator: Metro Manufacturing Inc., St. Paul, MN (651.776.5455)
2. Manufacturer of comparable products.

2.2 FERROUS METALS

A. Stainless Steel:

1. Thickness: 3/16 inch.
2. Finish: Buff to satin swirled finish.
3. Fasteners: Concealed.

B. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron, ASTM A47, or cast steel, ASTM A27. Provide bolts, washers and shims as required, hot-dip galvanized, ASTM A153.

2.3 FABRICATION

A. Cutting and Shaping:

1. Laser Cut, Shear, punch metals cleanly, accurately. Remove burrs.
2. Ease exposed edges to radius of approximately 1/32 inch unless otherwise indicated.
3. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
4. Remove sharp or rough areas on exposed traffic surfaces.

B. Anchorage:

1. Provide for type indicated; coordinate with supporting structure.
2. Fabricate, space anchoring devices to provide adequate support for intended use.

C. Assembly:

1. Preassemble in shop to greatest extent possible.
2. Disassemble only as necessary for shipping, handling limitations.
3. Use connections that maintain structural value of joined pieces.
4. Clearly mark for reassembly and coordinated installation.
5. Cut, reinforce, drill, and tap miscellaneous metal work as indicated to receive finish hardware, screws, and similar items.

2.4 FINISHES

A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.

B. Verification of Conditions: Verify that Metal Fabrications may be installed in accordance with original design, pertinent codes and regulations, and pertinent portions of referenced standards.

C. Discrepancies: Immediately notify Architect. Do not proceed with installation in areas of discrepancy until fully resolved. Commencement of installation signifies acceptance of surface conditions.

3.2 PREPARATION

A. Coordination: 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.

B. Utilize templates and other systems required to ensure accurate placement of items that will be embedded in concrete and masonry.

3.3 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.

3.4 TOLERANCES

A. Install in required position and within following tolerances:

1. Maximum Variation From Plumb: 1/4 inch.
2. Maximum Offset From True Alignment: 1/4 inch.

END OF SECTION 057000

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood products.
2. Wood-preservative-treated lumber.
3. Fire-retardant-treated lumber.
4. Miscellaneous lumber.
5. Plywood backing panels.

B. Related Requirements:

1. Section 061600 "Sheathing" for sheathing, subflooring, and underlayment.

1.2 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal (38 mm actual) size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) size or greater but less than 5 inches nominal (114 mm actual) size in least dimension.

C. Exposed Framing: Framing not concealed by other construction.

D. Lumber grading agencies, and abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NLGA: National Lumber Grades Authority.
3. SPIB: The Southern Pine Inspection Bureau.
4. WCLIB: West Coast Lumber Inspection Bureau.
5. WWPA: Western Wood Products Association.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.

3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency in accordance with ASTM D5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates:

1. For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
2. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS

A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
4. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content:

1. Boards: 15 percent.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1, Use categories as follows:

1. UC2: Interior construction not in contact with ground but may be subject to moisture.

2. UC3B (Commodity Specification A): Uncoated sawn products in exterior construction not in contact with ground, exposed to all weather cycles including intermittent wetting but with sufficient air circulation for wood to dry. Excludes sawn products not in contact with ground but with ground contact-type hazards.

3. UC4A (Commodity Specification A): Non-critical sawn products in contact with ground and exposed to all weather cycles including continuous or prolonged wetting, and sawn products not in contact with ground but with ground contact-type hazards or that are critical or hard to replace.

4. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED LUMBER

A. General: Where fire-retardant-treated materials are indicated, materials are to comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested in accordance with ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Treatment is not to promote corrosion of metal fasteners.
2. Exterior Type: Treated materials are to comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to

accelerated weathering in accordance with ASTM D2898. Use for exterior locations and where indicated.

3. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested in accordance with ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
4. Design Value Adjustment Factors: Treated lumber is to be tested according to ASTM D5664 and design value adjustment factors are to be calculated according to ASTM D6841. For enclosed roof framing, framing in attic spaces, and where high temperature fire-retardant treatment is indicated, provide material with adjustment factors of not less than 0.85 modulus of elasticity and 0.75 for extreme fiber in bending for Project's climatological zone.

C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency and other information required by authorities having jurisdiction.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.

E. Application: Treat items indicated on Drawings.

2.4 MISCELLANEOUS LUMBER

A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Cants.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any of the following species:

1. Hem-fir (north); NLGA.
2. Mixed southern pine or southern pine; SPIB.
3. Spruce-pine-fir; NLGA.
4. Hem-fir; WCLIB or WWPA.
5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
6. Western woods; WCLIB or WWPA.
7. Northern species; NLGA.
8. Eastern softwoods; NeLMA.

C. Concealed Boards: 15 percent maximum moisture content and any of the following species and grades:

1. Mixed southern pine or southern pine; No. 2 grade; SPIB.
2. Hem-fir or hem-fir (north); Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.

3. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
4. Eastern softwoods; No. 2 Common grade; NeLMA.
5. Northern species; No. 2 Common grade; NLGA.
6. Western woods; Construction or No. 2 Common grade; WCLIB or WWPA.

D. Roofing Nailers: Structural- or No. 2-grade lumber or better; kiln-dried Douglas fir, southern pine, or wood having similar decay-resistant properties.

E. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.5 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch (19-mm) nominal thickness.

2.6 FASTENERS

A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches (38 mm) into wood substrate.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M or ASTM F2329.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC58, ICC-ES AC193, or ICC-ES AC308 as appropriate for the substrate.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.

D. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.

E. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches (2438 mm) o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches (2438 mm) o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal (38-mm actual) thickness.
3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. (9.3 sq. m) and to solidly fill space below partitions.
4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet (6 m) o.c.

F. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

G. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

H. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

I. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.10.1, "Fastening Schedule," in ICC's International Building Code (IBC).
2. ICC-ES evaluation report for fastener.

J. Securely attach roofing nailers to substrates by anchoring and fastening to withstand bending, shear, or other stresses imparted by Project wind loads and fastener-resistance loads as designed in accordance with ASCE/SEI 7.

K. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILERS

A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach wood blocking to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

3.3 PROTECTION

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

END OF SECTION 061000

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SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Parapet sheathing.
3. Sheathing joint-and-penetration treatment materials.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for plywood backing panels.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Wall sheathing.
2. Parapet sheathing.
3. Sheathing joint-and-penetration treatment materials.

B. Product Data Submittals: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency in accordance with ASTM D5516.
4. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. For air-barrier and water-resistant glass-mat gypsum sheathing, include manufacturer's technical data and tested physical and performance properties of products.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: From air-barrier and water-resistant glass-mat gypsum sheathing manufacturer, certifying compatibility of sheathing accessory materials with Project materials that connect to or that come in contact with the sheathing.

B. Product Test Reports: For each air-barrier and water-resistant glass-mat gypsum sheathing assembly, indicating compliance with specified requirements, for tests performed by a qualified testing agency.

C. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated plywood.
2. Fire-retardant-treated plywood.

D. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications:

1. For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: As tested in accordance with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 WOOD PANEL PRODUCTS

A. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

B. Factory mark panels to indicate compliance with applicable standard.

2.3 PRESERVATIVE-TREATED PLYWOOD

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.4 FIRE-RETARDANT-TREATED PLYWOOD

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested in accordance with ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Use treatment that does not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials are to comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering in accordance with ASTM D2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested in accordance with ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
4. Design Value Adjustment Factors: Treated lumber plywood is to be tested in accordance with ASTM D5516 and design value adjustment factors are to be calculated in accordance with ASTM D6305. Span ratings after treatment are to be not less than span ratings specified.

C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.

D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.

E. Application: Treat plywood indicated on Drawings, and the following:

2.5 WALL SHEATHING

A. Plywood Sheathing, Walls: Either DOC PS 1 or DOC PS 2, Exterior, Structural I sheathing.

1. Span Rating: Not less than 16/0.
2. Nominal Thickness: Not less than 1/2 inch (13 mm).

B. Oriented-Strand-Board Sheathing, Walls: DOC PS 2, Exposure 1, Structural I sheathing.

1. Span Rating: Not less than 16/0.
2. Nominal Thickness: Not less than 1/2 inch (13 mm).

C. Glass-Mat Gypsum Sheathing, Walls: ASTM C1177/C1177M.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. CertainTeed; SAINT-GOBAIN.
b. Georgia-Pacific Gypsum LLC.
c. USG Corporation.

2. Type and Thickness: Type X, 5/8 inch (15.9 mm) thick.

D. Cementitious Backer Units, Walls: ASTM C1325, Type A.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Custom Building Products.
b. USG Corporation.

2. Thickness: 5/8 inch (15.9 mm).

2.6 PARAPET SHEATHING

A. Plywood Sheathing, Parapets: Either DOC PS 1 or DOC PS 2, Exterior, Structural I sheathing.

1. Span Rating: Not less than 16/0.
2. Nominal Thickness: Not less than 1/2 inch (13 mm).

B. Oriented-Strand-Board Sheathing, Parapets: DOC PS 2, Exposure 1, Structural I sheathing.

1. Span Rating: Not less than 16/0.
2. Nominal Thickness: Not less than 1/2 inch (13 mm).

C. Glass-Mat Gypsum Sheathing, Parapets: ASTM C1177/C1177M.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. CertainTeed; SAINT-GOBAIN.
b. Gold Bond Building Products, LLC provided by National Gypsum Company.
c. USG Corporation.

2. Type and Thickness: Type X, 5/8 inch (15.9 mm) thick.

2.7 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For parapet and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Screws for Fastening Sheathing to Wood Framing: ASTM C1002.

E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.

1. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C1002.
2. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, use screws that comply with ASTM C954.

G. Screws for Fastening Composite Nail Base Insulated Roof Sheathing to Metal Roof Deck: Steel drill screws, in type and length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours in accordance with ASTM B117. Provide washers or plates if recommended by sheathing manufacturer.

2.8 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. Table 2304.10.1, "Fastening Schedule," in the ICC's International Building Code.
2. ICC-ES evaluation report for fastener.

D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate wall and parapet sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 INSTALLATION OF WOOD STRUCTURAL PANEL

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Wall and Roof Sheathing:

a. Screw to cold-formed metal framing.
b. Space panels 1/8 inch (3 mm) apart at edges and ends.

3.3 INSTALLATION OF GYPSUM SHEATHING

A. Comply with GA-253 and with manufacturer's written instructions.

1. Fasten gypsum sheathing to cold-formed metal framing with screws.

2. Install panels with a 3/8-inch (9.5-mm) gap where non-load-bearing construction abuts structural elements.
3. Install panels with a 1/4-inch (6.4-mm) gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent panels without forcing. Abut ends over centers of studs, and stagger end joints of adjacent panels not less than one stud spacing. Attach at perimeter and within field of panel to each stud.

1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of panels.

D. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.

1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of panels.

3.4 INSTALLATION OF CEMENTITIOUS BACKER UNITS

A. Install panels and treat joints in accordance with ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.5 FIELD QUALITY CONTROL

A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.

B. Testing and Inspecting Agency: Engage a qualified testing agency to perform tests and inspections.

C. Tests: As determined by testing agency from among the following tests:

1. Air-Leakage-Location Testing: Air-barrier sheathing assemblies will be tested for evidence of air leakage in accordance with ASTM E1186, chamber pressurization or depressurization with smoke tracers.
2. Air-Leakage-Volume Testing: Air-barrier assemblies will be tested for air-leakage rate in accordance with ASTM E783 or ASTM E2357.

D. Air barriers will be considered defective if they do not pass tests and inspections.

E. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

F. Prepare test and inspection reports.

END OF SECTION 061600

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SECTION 064116 - PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Plastic-laminate-faced architectural cabinets.
2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets unless concealed within other construction before cabinet installation.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets and concealed within other construction before cabinet installation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including panel products, high-pressure decorative laminate, adhesive for bonding plastic laminate and cabinet hardware and accessories.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details full size.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
3. Show locations and sizes of cutouts and holes for electrical switches and outlets and other items installed in architectural plastic-laminate cabinets.

C. Samples for Initial Selection:

1. Plastic laminates.
2. PVC edge material.
3. Thermoset decorative panels.

D. Samples for Verification:

1. Plastic laminates for each type, color, pattern, and surface finish and specified edge material.

2. Exposed cabinet hardware and accessories, one unit for each type and finish.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Product Certificates: For each type of product:

1. Composite wood and agrifiber products.
2. Thermoset decorative panels.
3. High-pressure decorative laminate.
4. Adhesives.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Fabricator shop does not need to be a certified participant in AWI's Quality Certification Program, however, the contractor must comply with AWI standards and their warrantees must meet or exceed AWI standards.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups of typical plastic-laminate cabinets as shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar operations that could damage woodwork have been completed in installation areas. If cabinets must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.7 FIELD CONDITIONS

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

B. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90

deg F (16 and 32 deg C) and relative humidity between 25 and 55 percent during the remainder of the construction period.

C. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.

D. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that cabinets can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL CABINET FABRICATORS

A. Fabricators: Subject to compliance with requirements.

2.2 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements.
1. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

B. Grade: Premium.

C. Type of Construction: Frameless.

D. Cabinet, Door, and Drawer Front Interface Style: Flush overlay.

E. Reveal Dimension: 1/2 inch (13 mm).

F. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Abet Laminati, Inc.
b. Formica Corporation.
c. Lamin-Art, Inc.
d. Panolam Industries International, Inc.
e. Pionite
f. Wilsonart International; Div. of Premark International, Inc.

G. Laminate Cladding for Exposed Surfaces:

1. Horizontal Surfaces: Grade HGS.
2. Postformed Surfaces: Grade HGP.
3. Vertical Surfaces: Grade HGS.
4. Edges: PVC edge banding, 0.12 inch (3 mm) thick, matching laminate in color, pattern, and finish.
5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.

H. Materials for Semi-exposed Surfaces:

1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade VGS.

a. Edges of Plastic-Laminate Shelves: PVC edge banding, 0.12 inch (3 mm) thick, matching laminate in color, pattern, and finish.
b. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
c. For semi-exposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.

2. Drawer Sides and Backs: Thermoset decorative panels with PVC or polyester edge banding.
3. Drawer Bottoms: Thermoset decorative panels.

I. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.

J. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.

K. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. PL-1: Wilsonart, Pewter Mesh 4878-38, Fine Velvet Finish,

2. PL-2: Wilsonart, Studio Teak 7960K-18

2.3 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Wood Moisture Content: 5 to 10 percent.

B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Medium-Density Fiberboard: ANSI A208.2, Grade 130 made with binder containing no urea formaldehyde.
2. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.
3. Softwood Plywood: DOC PS 1, medium-density overlay.
4. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.4 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.

B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening, self-closing.

C. Pulls: Stainless steel, 7-1/2” Amerock CTC Bar Pull.

D. Adjustable Shelf Standards and Supports: BHMA A156.9, B04102; with shelf brackets, B04112.

E. Drawer Slides: BHMA A156.9.

1. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
2. For drawers more than 3 inches (75 mm) high but not more than 6 inches (150 mm) high and not more than 24 inches (600 mm) wide, provide Grade 1HD-100.
3. For drawers more than 6 inches (150 mm) high or more than 24 inches (600 mm) wide, provide Grade 1HD-200.
4. For computer keyboard shelves, provide Grade 1HD-100.

F. Door Locks: BHMA A156.11, E07121.

G. Drawer Locks: BHMA A156.11, E07041.

H. Door and Drawer Silencers: BHMA A156.16, L03011.

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

1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.

J. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.5 MISCELLANEOUS MATERIALS

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

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

C. Adhesives: Do not use adhesives that contain urea formaldehyde.

D. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.

1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.6 FABRICATION

A. Fabricate cabinets to dimensions, profiles, and details indicated.

B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.

B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required.

3.2 INSTALLATION

A. Grade: Install cabinets to comply with same grade as item to be installed.

B. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.

C. Install cabinet(s) level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.

1. Use filler matching finish of items being installed.

F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semi-exposed surfaces.

END OF SECTION 064116

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SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Extruded polystyrene foam-plastic board insulation.
2. Mineral-wool blanket insulation.

B. Related Requirements:

1. Section 072119 "Foamed-in-Place Insulation" for spray-applied polyurethane foam insulation.
2. Section 075323 "Ethylene-Propylene-Diene-Monomer (EPDM) Roofing" for insulation specified as part of roofing construction.
3. Section 092900 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Extruded polystyrene foam-plastic board insulation.
2. Mineral-wool blanket insulation.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

B. Research Reports: For foam-plastic insulation, from ICC-ES.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.

3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. DiversiFoam Products.
   b. Dow Chemical Company (The).
   c. Owens Corning.

2. Type IV, 25 psi (173 kPa), R-15.
3. For insulation board under concrete slab to receive radiant in-floor heating and at perimeter of building:
   a. Type VI extruded polystyrene with minimum 40 psi compressive stress and sub-grade / foundation modulus (k) equal to or exceeding 750 pci for 3” board thickness. Owens Corning FOAMULAR 400, Insulfoam R-Tech VI, or approved equal.

2.2 MINERAL-WOOL BLANKET INSULATION

A. Mineral-Wool Blanket Insulation, Unfaced: ASTM C665, Type I (blankets without membrane facing); consisting of fibers; passing ASTM E136 for combustion characteristics.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Johns Manville; a Berkshire Hathaway company.
   b. Owens Corning.
   c. ROCKWOOL.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Install insulation with manufacturer's R-value label exposed after insulation is installed.

D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF SLAB INSULATION

A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.

1. If not otherwise indicated, extend insulation a minimum of 48 inches below exterior grade line.

B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

1. If not otherwise indicated, extend insulation a minimum of 48 inches in from exterior walls.
2. Areas receiving radiant in-floor heating are to have insulation extend under the entire concrete slab.

3.4 INSTALLATION OF FOUNDATION WALL INSULATION

A. Butt panels together for tight fit.

B. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:

1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions.
2. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application.
3. Apply insulation standoffs to each spindle to create cavity width indicated on Drawings between concrete substrate and insulation.
4. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation.

5. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

C. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.

3.5 INSTALLATION OF CAVITY-WALL INSULATION

A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face and as recommended by manufacturer.

1. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions, and with faces flush.
2. Press units firmly against inside substrates.

3.6 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

3.7 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 072119 - FOAMED-IN-PLACE INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Closed-cell spray polyurethane foam.

B. Related Requirements:

1. Section 072100 "Thermal Insulation" for foam-plastic board insulation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Evaluation Reports: For spray-applied polyurethane foam-plastic insulation, from ICC-ES.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 CLOSED-CELL SPRAY POLYURETHANE FOAM

A. Closed-Cell Spray Polyurethane Foam: ASTM C 1029, Type II, minimum density of 1.5 lb/cu. ft. (24 kg/cu. m) and minimum aged R-value at 1-inch (25.4-mm) thickness of 6.2 deg F x h x sq. ft./Btu at 75 deg F (43 K x sq. m/W at 24 deg C).

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. BASF Corporation.
   b. Dow Chemical Company (The).
   c. Icynene Inc.

2. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

   a. Flame-Spread Index: 25 or less.
   b. Smoke-Developed Index: 450 or less.

3. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

4. R-Value: Spray Foam insulation thickness to meet a minimum R-Value of R-18.

2.2 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by insulation manufacturer where required for adhesion of insulation to substrates.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify that substrates are clean, dry, and free of substances that are harmful to insulation.

B. Priming: Prime substrates where recommended by insulation manufacturer. Apply primer to comply with insulation manufacturer's written instructions. Confine primers to areas to be insulated; do not allow spillage or migration onto adjoining surfaces.

3.2 INSTALLATION

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Spray insulation to envelop entire area to be insulated and fill voids.

C. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.

D. Framed Construction: Install into cavities formed by framing members to achieve thickness of 2 inches.

E. Miscellaneous Voids: Apply according to manufacturer's written instructions.

3.3 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

END OF SECTION 072119

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SECTION 072726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. High-build air barriers, vapor permeable.

B. Related Requirements:

1. Section 061600 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.

1.2 DEFINITIONS

A. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

B. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

C. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.4 ACTION SUBMITTALS

A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; dry film thickness; and tested physical and performance properties of products.

B. Shop Drawings: For air-barrier assemblies.

1. Show locations and extent of air-barrier materials, accessories, and assemblies specific to Project conditions.
2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
3. Include details of interfaces with other materials that form part of air barrier.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.

C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1. Installer to be licensed by ABAA in accordance with ABAA's Quality Assurance Program and to employ ABAA-certified installers and supervisors on Project.

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

1. Build integrated mockups of exterior wall assembly, incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.

a. Include junction with roofing membrane.
b. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Remove and replace liquid materials that cannot be applied within their stated shelf life.

B. Protect stored materials from direct sunlight.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.

1. Protect substrates from environmental conditions that affect air-barrier performance.
2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain primary air-barrier materials and air-barrier accessories from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction to be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies to be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.2 L/s x sq. m of surface area at 75 Pa), when tested in accordance with ASTM E2357.

C. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75 Pa) pressure difference; ASTM E2178.

D. Ultimate Elongation: Minimum 200 percent; ASTM D412, Die C.

E. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.3 HIGH-BUILD AIR BARRIERS, VAPOR PERMEABLE

A. High-Build, Vapor-Permeable Air Barrier, Modified Bituminous Type: Modified Bituminous membrane with an installed dry film thickness, according to manufacturer's written instructions, of 35 mils (0.9 mm) or thicker over smooth, void-free substrates.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Tremco Incorporated.
    b. TK Products AirMax 2104

B. High-Build, Vapor-Permeable Air Barrier, Synthetic Polymer Type: Synthetic polymer membrane with an installed dry film thickness, according to manufacturer's written instructions, of 35 mils (0.9 mm) or thicker over smooth, void-free substrates.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. DuPont de Nemours, Inc.
    b. Tremco Incorporated.
    c. PROSOCO, Inc.

C. Vapor Permeance: Minimum 10 perms (580 ng/Pa x s x sq. m); ASTM E96/E96M,.

2.4 ACCESSORY MATERIALS

A. Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.

B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.

C. Stainless Steel Sheet: ASTM A240/A240M, Type 304, 0.0187 inch (0.5 mm) thick, and Series 300 stainless steel fasteners.

D. Preformed Silicone Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. PROSOCO, Inc.
    b. Tremco Incorporated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
3. Verify that substrates are visibly dry and free of moisture.
4. Verify that masonry joints are flush and completely filled with mortar.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate in accordance with manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 INSTALLATION OF ACCESSORIES

A. Install accessory materials in accordance with air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.

1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate.
3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.

B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

D. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

E. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip or preformed silicone extrusion so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate. Maintain 3 inches (75 mm) of full contact over firm bearing to perimeter frames, with not less than 1 inch (25 mm) of full contact.

1. Transition Strip: Roll firmly to enhance adhesion.
2. Preformed Silicone Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material.

F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.

G. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.

H. Seal top of through-wall flashings to air barrier with an additional 6-inch- (150-mm-) wide, transition strip.

I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

J. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches (150 mm) beyond repaired areas in strip direction.

3.4 INSTALLATION OF PRIMARY AIR-BARRIER MATERIAL

A. Apply air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier in accordance with air-barrier manufacturer's written instructions and details. Apply air-barrier material within manufacturer's recommended application temperature ranges.

1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
2. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
3. Where multiple prime coats are needed to achieve required bond, allow adequate drying time between coats.

B. High-Build Air Barriers: Apply continuous unbroken air-barrier material to substrates according to the following thickness. Apply air-barrier material in full contact around protrusions such as masonry ties.

1. Vapor-Permeable, High-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, but not less than 35 mils (0.9 mm), applied in one or more equal coats.

C. Do not cover air barrier until it has been tested and inspected by testing agency.

D. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.5 FIELD QUALITY CONTROL

A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:

1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Air-barrier dry film thickness.
3. Continuous structural support of air-barrier system has been provided.
4. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
5. Site conditions for application temperature and dryness of substrates have been maintained.
6. Maximum exposure time of materials to UV deterioration has not been exceeded.
7. Surfaces have been primed, if applicable.
8. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
9. Termination mastic has been applied on cut edges.
10. Strips and transition strips have been firmly adhered to substrate.
11. Compatible materials have been used.
12. Transitions at changes in direction and structural support at gaps have been provided.
13. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
14. All penetrations have been sealed.

D. Air barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional air-barrier material, in accordance with manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for retesting as specified above.

E. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

F. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, in accordance with manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials in accordance with air-barrier manufacturer's written instructions.
2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

C. Remove masking materials after installation.

END OF SECTION 072726

SECTION 074213 - INSULATED METAL WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Foamed-insulation-core metal wall panels.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Foamed-insulation-core metal wall panels.

B. Product Data Submittals: For each product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

C. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches (1:10).

D. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

E. Samples for Verification: For each type of exposed finish, prepared on Samples of size indicated below.

1. Metal Panels: 12 inches (305 mm) long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

1.7 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed in accordance with manufacturers' written instructions and warranty requirements.

1.8 COORDINATION

A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.

b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing in accordance with ASTM E72:

1. Wind Loads: As indicated on Drawings.
2. Deflection Limits: For wind loads, no greater than 1/180 of the span.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested in accordance with ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).

C. Water Penetration under Static Pressure: No water penetration when tested in accordance with ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

E. Fire-Test-Response Characteristics: Provide metal wall panels and system components with the following fire-test-response characteristics, as determined by testing identical panels and system components per test method indicated below by UL or another testing and inspecting agency

acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.

1. Fire-Resistance Characteristics: Provide materials and construction tested for fire resistance per ASTM E119.
2. Intermediate-Scale Multistory Fire Test: Tested mockup, representative of completed multistory wall assembly of which wall panel is a part, complies with NFPA 285 for test method and required fire-test-response characteristics of exterior non-load-bearing wall panel assemblies.
3. Radiant Heat Exposure: No ignition when tested in accordance with NFPA 268.
4. Potential Heat: Acceptable level when tested in accordance with NFPA 259.
5. Surface-Burning Characteristics: Provide wall panels with a flame-spread index of 25 or less and a smoke-developed index of 450 or less, per ASTM E84.

2.2 FOAMED-INSULATION-CORE METAL WALL PANELS

A. General: Provide factory-formed and -assembled metal wall panels fabricated from two metal facing sheets and insulation core foamed in place during fabrication, and with joints between panels designed to form weathertight seals. Include accessories required for weathertight installation.

1. Insulation Core: Modified isocyanurate or polyurethane foam using a non-CFC blowing agent, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively.

   a. Closed-Cell Content: 90 percent when tested in accordance with ASTM D6226.
   b. Density: 2.0 to 2.6 lb/cu. ft. (32 to 42 kg/cu. m) when tested in accordance with ASTM D1622.
   c. Compressive Strength: Minimum 20 psi (140 kPa) when tested in accordance with ASTM D1621.
   d. Shear Strength: 26 psi (179 kPa) when tested in accordance with ASTM C273/C273M.

B. Concealed-Fastener, Foamed-Insulation-Core Metal Wall Panels: Formed with tongue-and-groove panel edges; designed for sequential installation by interlocking panel edges and mechanically attaching panels to supports using concealed clips or fasteners.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. CENTRIA, a Nucor Brand.
   b. Kingspan Insulated Panels, Inc.
   c. MBCI; Cornerstone Building Brands.
   d. Metl-Span; a Nucor Brand.
      1) Basis of Design: Metl-Span, CF-Tuff-Cast

2. Metallic-Coated Steel Sheet: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150)

coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

a. Nominal Thickness: 22 gauge thickness.
b. Exterior Finish: Fiber-reinforced polymer coating.

1) Color: As selected by Architect from manufacturer's full range.

3. Snap-on Batten: Same material, finish, and color as exterior facings of wall panels.
4. Panel Coverage: 42 inches.
5. Panel Thickness: 3.0 inches (76 mm).
6. Thermal-Resistance Value (R-Value): 15.0 in accordance with ASTM C1363.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A792/A792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.

2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.4 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

C. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations

in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Steel Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.
3. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.

a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages in accordance with ASTM C754 and metal panel manufacturer's written recommendations.

3.3 INSTALLATION OF METAL PANELS

A. General: Install metal panels in accordance with manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Steel Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weathertight performance of metal wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal wall panel manufacturer.

1. Seal metal wall panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal wall panel manufacturer.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

3.4 INSTALLATION OF INSULATION-CORE METAL WALL PANELS

A. General: Apply continuous ribbon of sealant to panel joint on concealed side of insulated metal wall panels as vapor seal; apply sealant to panel joint on exposed side of panels for weather seal.

1. Fasten foamed-insulation-core metal wall panels to supports with fasteners at each lapped joint at location and spacing and with fasteners recommended by manufacturer.
2. Apply panels and associated items true to line for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
3. Provide metal-backed washers under heads of exposed fasteners on weather side of insulated metal wall panels.

4. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
5. Provide sealant tape at lapped joints of insulated metal wall panels and between panels and protruding equipment, vents, and accessories.
6. Apply a continuous ribbon of sealant tape to panel side laps and elsewhere as needed to make panels weathertight.

B. Foamed-Insulation-Core Metal Wall Panels: Fasten metal wall panels to supports with concealed clips at each joint at location and spacing and with fasteners recommended by manufacturer. Fully engage tongue and groove of adjacent panels.

1. Install clips to supports with self-tapping fasteners.

C. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.

D. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to achieve waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Water-Spray Test: After installation, test area of assembly as directed by Architect for water penetration in accordance with AAMA 501.2.

C. Metal wall panels will be considered defective if they do not pass test and inspections.

D. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

E. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

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

B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074213.19

SECTION 075323 - ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ethylene-propylene-diene-terpolymer (EPDM) roofing.
2. Accessory roofing materials.
3. Roof insulation.
4. Insulation accessories.
5. Walkways.

B. Related Requirements:

1. Section 061000 "Rough Carpentry for wood nailers, curbs, and blocking.
2. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
3. Section 077100 "Roof Specialties" for manufactured copings.
4. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.2 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D1079 and glossary of NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to work of this Section.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Ethylene-propylene-diene-terpolymer (EPDM) roofing.
2. Accessory roofing materials.
3. Roof insulation.
4. Insulation accessories and cover board.
5. Walkways.

B. Product Data Submittals:

1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.

C. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane terminations.

3. Flashing details at penetrations.
4. Tapered insulation, thickness, and slopes.
5. Roof plan showing orientation of steel roof deck and orientation of roof membrane and fastening spacings and patterns for mechanically fastened roofing system.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
7. Tie-in with air barrier.

D. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

a. Submit evidence of complying with performance requirements.

2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

C. Product Test Reports: For components of roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.

D. Evaluation Reports: For components of roofing system, from ICC-ES.

E. Field quality-control reports.

F. Sample Warranties: For manufacturer's special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is listed in FM Approvals' RoofNav for roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.8 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed in accordance with manufacturer's written instructions and warranty requirements.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, and other components of roofing system.
2. Warranty Period: 20 years from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing system and base flashings to withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and flashings to remain watertight.

1. Accelerated Weathering: Roof membrane to withstand 2000 hours of exposure when tested in accordance with ASTM G152, ASTM G154, or ASTM G155.

2. Impact Resistance: Roof membrane to resist impact damage when tested in accordance with ASTM D3746, ASTM D4272, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.

B. Material Compatibility: Roofing materials to be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.

C. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and are listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.

1. Fire/Windstorm Classification: Class 1A-90.
2. Hail-Resistance Rating: FM Global Property Loss Prevention Data Sheet 1-34 MH.

2.2 ETHYLENE-PROPYLENE-DIENE-TERPOLYMER (EPDM) ROOFING

A. EPDM Sheet: ASTM D4637/D4637M, Type I, nonreinforced, EPDM sheet.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Carlisle Syntec Systems.
b. Mule-Hide Products Co., Inc.
c. Versico Roofing Systems; Carlisle Construction Materials.

2. Thickness: 60 mils (1.5 mm), nominal.
3. Exposed Face Color: Black.

2.3 ACCESSORY ROOFING MATERIALS

A. General: Accessory materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.

1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: 60-mil- (1.5-mm-) thick EPDM, partially cured or cured, according to application.

C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

D. Bonding Adhesive: Manufacturer's standard.

E. Seaming Material: Manufacturer's standard, synthetic-rubber polymer primer and 3-inch- (75-mm-) wide minimum, butyl splice tape with release film.

F. Lap Sealant: Manufacturer's standard, single-component sealant.

G. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.

H. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

I. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick (25 mm wide by 1.3 mm thick), prepunched.

J. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening components to substrate, and acceptable to roofing system manufacturer.

K. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, molded pipe boot flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

2.4 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by EPDM roof membrane manufacturer, approved for use in FM Approvals' RoofNav-listed roof assemblies.

B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1 felt facer on both major surfaces.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Atlas Polyiso Roof and Wall Insulation.
b. Carlisle Syntec Systems.
c. CertainTeed; SAINT-GOBAIN.
d. Johns Manville; a Berkshire Hathaway company.

C. Composite Polyisocyanurate Board Insulation: ASTM C1289, with factory-applied facing board on one major surface, as indicated below by type, and felt or glass-fiber mat facer on the other.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Atlas Polyiso Roof and Wall Insulation.
b. Carlisle Syntec Systems.
c. CertainTeed; SAINT-GOBAIN.
d. Johns Manville; a Berkshire Hathaway company.

2. Facer: Type VII, glass-mat-faced gypsum board facer, 1/4 inch (6 mm) thick.

D. Tapered Insulation: Provide factory-tapered insulation boards.

1. Material: Match roof insulation.

2. Minimum Thickness: 1/4 inch (6.35 mm).
3. Slope:

    a. Roof Field: 1/4 inch per foot (1:48) unless otherwise indicated on Drawings.
    b. Saddles and Crickets: 1/2 inch per foot (1:24) unless otherwise indicated on Drawings.

2.5 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

C. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric; water permeable and resistant to UV degradation; type and weight as recommended by roofing system manufacturer for application.

2.6 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads, approximately 3/16 inch (5 mm) thick and acceptable to roofing system manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation in accordance with roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.3 INSTALLATION OF ROOFING, GENERAL

A. Install roofing system in accordance with roofing system manufacturer's written instructions, FM Approvals' RoofNav assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

C. Install roof membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition.

D. Coordinate installation and transition of roofing system component serving as an air barrier with air barrier specified under Section 072726 "Fluid-Applied Membrane Air Barriers."

3.4 INSTALLATION OF INSULATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.

B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Installation Over Metal Decking:

1. Install base layer of insulation with end joints staggered not less than 12 inches (305 mm) in adjacent rows and with long joints continuous at right angle to flutes of decking.

    a. Locate end joints over crests of decking.
    b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
    d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).

        1) Trim insulation so that water flow is unrestricted.

    e. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
    f. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
    g. Mechanically attach base layer of insulation using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.

1) Fasten insulation in accordance with requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.

2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches (305 mm) from previous layer of insulation.

a. Install with long joints continuous and with end joints staggered not less than 12 inches (305 mm) in adjacent rows.
b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches (610 mm).
e. Trim insulation so that water flow is unrestricted.
f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
h. Adhere each layer of insulation to substrate using adhesive in accordance with FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29, as follows:

1) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.5 INSTALLATION OF ADHERED ROOF MEMBRANE

A. Adhere roof membrane over area to receive roofing in accordance with roofing system manufacturer's written instructions.

B. Unroll membrane roof membrane and allow to relax before installing.

C. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer, and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.

E. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeters.

F. Apply roof membrane with side laps shingled with slope of roof deck where possible.

G. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement.

1. Firmly roll side and end laps of overlapping roof membrane to ensure a watertight seam installation.
2. Apply lap sealant and seal exposed edges of roofing terminations.

3. Apply a continuous bead of in-seam sealant before closing splice if required by roofing system manufacturer.

H. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

I. Spread sealant or mastic bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.6 INSTALLATION OF BASE FLASHING

A. Install sheet flashings and preformed flashing accessories, and adhere to substrates in accordance with roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.7 INSTALLATION OF WALKWAYS

A. Flexible Walkways: Install walkway products in accordance with manufacturer's written instructions.

1. Install flexible walkways at the following locations:

   a. Perimeter of each rooftop unit.
   b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
   c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
   d. Locations indicated on Drawings.
   e. As required by roof membrane manufacturer's warranty requirements.

2. Provide 6-inch (76-mm) clearance between adjoining pads.
3. Adhere walkway products to substrate with compatible adhesive in accordance with roofing system manufacturer's written instructions.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to inspect substrate conditions, surface preparation, roof membrane application, sheet flashings, protection, and drainage components, and to furnish reports to Architect.

B. Perform the following tests:

1. Flood Testing: Flood test each roofing area for leaks, in accordance with recommendations in ASTM D5957, after completing roofing and flashing. Install temporary containment assemblies, plug or dam drains, and flood with potable water.

a. Perform tests before overlying construction is placed.
b. Flood to an average depth of 2-1/2 inches (65 mm) with a minimum depth of 1 inch (25 mm) and not exceeding a depth of 4 inches (100 mm). Maintain 2 inches (50 mm) of clearance from top of base flashing.
c. Flood each area for 24 hours.
d. After flood testing, repair leaks, repeat flood tests, and make further repairs until roofing and flashing installations are watertight.

1) Cost of retesting is Contractor's responsibility.

e. Testing agency to prepare survey report indicating locations initial leaks, if any, and final survey report.

C. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.

D. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.9 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and in accordance with warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075323

SECTION 076200 – SHEET METAL FLASHING AND TRIM

PART 1 PRODUCTS

1.1 SUMMARY

A. Provide sheet metal flashing and trim for:

1. Metal counter flashing and base flashing.
2. Exterior wall flashing and expansion joints.
3. Roof flashing and accessories.
4. Fascia
5. Exposed metal trim and facia units.
6. Reglets.
7. Sheet metal accessories including, but not limited to:
    a. Joint sealants for sheet metal flashing.
    b. Water barrier membrane.
    c. Fasteners.

B. Related Sections:

1. Section 042200 – Concrete Unit Masonry
2. Section 061000 - Rough Carpentry
3. Section 075323 - EPDM Membrane Roofing
4. Section 079200 - Joint Sealants

1.2 REFERENCES

A. ASTM:

1. A167 - Stainless and Heat Resistant Chromium Nickel Steel Plate, Sheet
2. A653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Coated (Galvannealed) by the Hot-Dip Process
3. A853 - Steel Wire, Carbon
4. B32 - Specifications for Solder Metal
5. B209 - Aluminum Sheet and Plate
6. C920 - Elastomeric Joint Sealants
7. D522 - Mandrel Test for Organic Coatings, Formability
8. D1970 - Self-Adhering Polymer Modified Bituminous Sheet Materials
9. D2244 - Color Tolerances
10. D2794 - Impact Resistance
11. D4214 - Evaluation of Degree of Chalking
12. E111 - Modulus Testing, Elasticity
13. E228 - Test for Thermal Expansion
14. G90 - Performing Accelerated Weathering of Non-Metallic Materials

B. SMACNA: Architectural Sheet Metal Manual

1.3 SYSTEM DESCRIPTION

A. Design Requirements: Provide watertight metal copings on entire roof perimeter.

B. Performance Requirements: Sheet metal flashing and trim shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing.

1.4 SUBMITTALS

A. Reference: Refer to Section 013300.

B. Product Data: Submit manufacturer's current Product Data including specifications, handling, storage and installation instructions, and maintenance recommendations.

C. Shop Drawings: Include layout, profiles, methods of joining, and anchorage details.

D. Samples:

1. Color: Submit manufacturer's standard color samples with Product Data and Shop Drawings.
2. Samples of sheet metal flashing, trim, and accessory items in specified finish, showing full range of variations expected.

1.5 QUALITY ASSURANCE

A. Single Source Responsibility: Provide sheet metal flashing and trim units made of components of standard construction furnished by 1 manufacturer as coordinated assemblies.

B. Qualifications:

1. Manufacturer: 5 years experience in the manufacture of sheet metal flashing and trim.
2. Contractor: 3 years experience in the installation of sheet metal flashing and trim.
3. Personnel: For actual installation of sheet metal flashing and trim, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of work.

C. Regulatory Agencies:

1. Meet UL requirements for fire resistance of roof covering materials and impact resistance.
2. Meet wind/uplift resistance of ANSI/SPRI ES 1 per IBC.

1.6 PROJECT CONDITIONS

A. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

1.7 COORDINATION

A. Furnish metal base flashings and other work required to be built into roofing and flashing promptly so roofing operations may be carried on continuously to completion without delay.

1.8 WARRANTIES

A. Manufacturer: Non-prorated 20-year written warranty covering fade, chalking and film integrity including labor and material through the 20th year.

B. Contractor:
   1. Sheet metal system and related flashing shall be warranted in writing stipulating that Contractor agrees to maintain metal flashing system in a watertight condition for a period of 5 years at the Contractor's own expense.
   2. Warranty shall cover any condition caused by defective material and the installation and ordinary wear and tear.
   3. Warranty does not cover damage due to natural disaster not covered by insurance, accidents, misuse or vandalism.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Flashing and Trim:
   1. Standard of Quality: Design is based on UnaClad, Firestone Metal Products www.unaclad.com
   2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
      a. Berridge Manufacturing, Houston, TX www.berridge.com
      b. MM Systems, Pendergrass, GA www.mmsystemscorp.com
      c. PacClad, Elk Grove Village, IL www.pac-clad.com
      d. Manufacturer of comparable products.

B. Manufactured Products:
   1. Standard of Quality: Design is based on Metal Era www.metalera.com
   2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
      a. Metal Era www.metalera.com
      b. Manufacturer of comparable products.

2.2 MATERIALS

A. Sheet Metal:
   1. Verify recycled content from manufacturer.
   2. Performance Requirements:
      a. Color Change: ASTM D2244, Not greater than 5 NBS color units.
      b. Chalking: 8 or better, ASTM D4214.
      c. Minimum yield: ASTM A853.
      d. Formability: ASTM D522.
      e. M.O.E.: ASTM E111.

f. COTE: ASTM E228.
g. Impact resistance: ASTM D2794, 70 inch/pound, no tape pick-off.

3. Aluminum: ASTM B209, alloy 3003, temper H14 unless harder temper required for forming and performance, AA-C22A41 clear anodized finish; 0.032 inch thick (20 gage), except as otherwise indicated.

B. Fascia Panels:
1. Minimum 0.063 aluminum sheet.
2. Match hidden splice plates of thickness as recommended by manufacturer.

2.3 SHEET METAL ACCESSORIES

A. Nails and Fasteners:
1. Galvanized nails and cadmium-plated screws and washers in connection with galvanized iron and steel, which will not stain, produce electrolytic reaction or be detrimental to complete installation.
2. Same metal as sheet metal flashing or recommended by sheet metal manufacturer. Avoid noncompatible or dissimilar metals due to risk of galvanic corrosion.
3. Match finish of exposed heads with material being fastened.

B. Solder: ASTM B32.
1. Copper: Grade Sn50, 50 percent lead, 50 percent tin solder, commercial soldering flux.
2. Lead-coated copper: Grade Sn60, 60 percent in and 40 percent lead.
3. Stainless steel: Grade Sn60 with acid flux of type recommended by stainless steel sheet manufacturer.
4. Zinc: 60 percent lead and 40 percent tin with low antimony.

C. Joint Sealant: See Section 07 92 00.

D. Adhesives: Recommended by flashing sheet metal manufacturer for waterproof and weather-resistant seaming and adhesive application of flashing sheet metal.

E. Other Materials: Other materials not specifically described but required for complete, proper installation of sheet metal and flashing, subject to acceptance of Architect.

2.4 MANUFACTURED PRODUCTS

A. Reglets:
1. Factory-mitered and welded corners and junctions.
2. Material: Stainless steel.
3. Type: As required.

B. Flashings and Fascia:
1. Preformed Coping and Fascia:
a. 0.063 aluminum formline assembly.
b. Height at exposed face: Refer to drawings.
c. Furnish with continuous cleats to support edge of external leg and interior leg.
d. Miter corners, seal, and solder or weld watertight.
2. Formed Fascia Spillout Scupper:

a. Minimum 0.063 aluminum sheet.

2.5 WATER BARRIER MEMBRANE

A. Cold-applied Self-adhering Membrane:
1. High-strength polyethylene film coated on 1 side with a thick layer of adhesive consistency rubberized asphalt.
2. Membrane to be able to withstand temperature of 200 degrees F without adhesive degradation.
3. ASTM D1970.
4. Thickness: 0.004 inch.
5. Provide complete with manufacturer's recommended primer.

2.6 FABRICATION

A. General Requirements:
1. Comply with SMACNA's "Architectural Sheet Metal Manual."
2. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Fabricate with strippable film in place.
4. Accurately form with brakes, straight, true, and sharp; plain surfaces free from warps and buckles and tool marks.
5. Fabricate nonmoving seams with flat-lock seams. Where joint movement is necessary, provide 1-inch-deep interlocking hooked flanges, filled with mastic sealant.
6. Tin edges to be seamed, form seams, and solder.
7. Match profiles exactly at connections.
8. Exposed edges to be beaded or returned for strength and appearance.
9. Allow for expansion and contraction.

B. Reinforcement: Provide ribs, cleats, and reinforcement necessary to make sections rigid and substantial.

C. Seams, Joints:
1. Locate joints of roof edges, other sheet metal work exposed to view with respect to control joints and other architectural features as indicated on Drawings or as directed by Architect.
2. Overlap in direction of flow.
3. Use concealed cover plates.
4. Where appearance is not a factor, fabricate in 8 or 10-foot lengths.
5. Design field joints to permit expansion.
6. Use joint covers or lapped joints with "s" clips; do not solder.
7. Locate field joints at least 12 inches, no more than 3 feet, from actual corner.
8. Provide 4-inch-wide flanges for setting on built-up asphalt roofing system membrane with concealment by composition stripping.

D. Penetration Sleeves: Fabricate with minimum 8-inch-high stack, of diameter 1 inch larger than penetrating element.

2.7 FINISHES

A. Coating System: 2-coat system of organic coating on the face side consisting of fluorocarbon base top coat applied over quality matched primer with white wash coat applied to back side for additional protection.

1. Colors: Up to 3 colors will be selected by Architect from standard range of smooth finishes.

PART 3 EXECUTION

3.1 EXAMINATION

A. Work of Other Trades:
1. Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.
2. Coordinate Work with interfacing and adjoining Work, for proper sequencing of each installation.
3. Ensure best possible weather resistance, durability of Work, and protection of materials and finishes.

B. Verification of Conditions: Verify that flashing and sheet metal may be installed in accordance with original design, pertinent codes and regulations, and pertinent portions of referenced standards.

C. Discrepancies: Immediately notify Architect. Do not proceed with installation in areas of discrepancy until fully resolved.

3.2 METAL PROTECTION

A. Do not place dissimilar metals in contact nor in position where drainage will occur across them.

B. Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.

C. Water Barrier Membrane:
1. Install as recommended by manufacturer at locations indicated on Drawings.
2. Use of primer is required.

3.3 INSTALLATION

A. General:
1. Apply fabrication instructions of this Section to field installation.
2. Install with strippable film in place.
3. Install work neatly and anchor securely.
4. Overlap seams in direction of flow and slope all horizontal surfaces for drainage.
5. Join parts with rivets or sheet metal screws where necessary for strength or stiffness.

6. Whenever possible, secure metal by means of clips or cleats without nailing through metal, in no case shall nails, rivets, or screws be exposed on outside of fascia, copings, etc.
7. Secure metal flashings at roof edges according to ANSI/SPRI ES 1 Loss Prevention Data Sheet 1-49 for wind zone of Project.
8. Equipment support flashing: Coordinate with roofing and equipment installation. Weld or seal flashing to equipment support member.
9. Finished work to be water, weather tight.

B. Expansion Provisions:
1. Provide for thermal expansion of exposed flashing and trim.
2. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner of intersection.
3. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with elastomeric sealant concealed within joints.

C. Joint Sealants: Apply wherever required to ensure watertight installation of sheet metal flashing after removing protective film.

3.4 ADJUSTING

A. Replace or repair sheet metal flashing and trims that have been damaged or deteriorated beyond successful repair by finish touching or similar repair procedures.

3.5 CLEAN UP

A. Immediately after completing work, remove strippable film.

B. Clean sheet metal surfaces with mild soap and water to be suitable to receive specified finishes.

C. Remove substances that might cause corrosion of metal or deterioration of finishes.

3.6 PROTECTION

A. Provide final protection and maintain conditions to ensure flashing and trim are without damage or deterioration other than natural weathering at the time of Substantial Completion.

END OF SECTION

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SECTION 077100 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Copings.
2. Reglets and counterflashings.

B. Related Sections:

1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 077200 "Roof Accessories" for roof hatches and other manufactured roof accessory units.
3. Section 079200 "Joint Sealants" for field-applied sealants between roof specialties and adjacent materials.

1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Roof specialties shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. SPRI Wind Design Standard: Manufacture and install copings tested according to SPRI ES-1 and capable of resisting the following design pressures:

1. Design Pressure: As indicated on Drawings.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C) material surfaces.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof specialties. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work. Include the following:

1. Details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.
2. Pattern of seams and layout of fasteners, cleats, clips, and other attachments.
3. Details of termination points and assemblies, including fixed points.
4. Details of special conditions.

C. Samples for Initial Selection: For each type of roof specialty indicated with factory-applied color finishes.

D. Samples for Verification: For copings, reglets and counterflashings made from 12-inch (300-mm) lengths of full-size components including fasteners, cover joints, accessories, and attachments.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for copings.

B. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical roof coping approximately 10 feet long, including supporting construction, seams, attachments, underlayment and accessories.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.

B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof specialties installation.

1.9 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 EXPOSED METALS

A. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.

1. Surface: Smooth, flat finish.
2. Mill Finish: As manufactured.
3. Exposed Coil-Coated Finishes: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

a. Two-Coat Fluoropolymer: AAMA 620. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.
b. Concealed Surface: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by manufacturer for type of use and finish indicated, finished as follows:

1. Exposed High-Performance Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

a. Two-Coat Fluoropolymer: AAMA 2605 System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.

2.2 CONCEALED METALS

A. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy and temper recommended by manufacturer for type of use and structural performance indicated, mill finished.

B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by manufacturer for type of use and structural performance indicated, mill finished.

C. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.

D. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation.

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:

1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
2. Fasteners for Copper Sheet: Copper, hardware bronze, or passivated Series 300 stainless steel.
3. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.
4. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
5. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.

C. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane or silicone polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

D. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

E. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

F. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.4 COPINGS

A. Copings: Manufactured coping system consisting of formed-metal coping cap in section lengths not exceeding 12 feet (3.6 m), concealed anchorage; corner units, end cap units, and concealed splice plates with same finish as coping caps.

1. Basis of Design: Metal-Era, Inc. Perma-Tite Continuous Cleat Coping or approved equal.

2. Coping-Cap Material: Formed aluminum, thickness as required to meet performance requirements.

   a. Finish: Two-coat fluoropolymer.
   b. Color: As selected by Architect from manufacturer's full range.

3. Corners: Factory mitered and continuously welded.
4. Coping-Cap Attachment Method: Face leg hooked to continuous cleat with back leg fastener exposed, fabricated from coping-cap material.
5. Face Leg Cleats: Concealed, continuous galvanized-steel sheet.

2.5 REGLETS AND COUNTERFLASHINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Castle Metal Products.
2. Cheney Flashing Company.
3. Fry Reglet Corporation.
4. Heckmann Building Products Inc.
5. Hickman Company, W. P.
6. Keystone Flashing Company, Inc.
7. Metal-Era, Inc.
8. Metal-Fab Manufacturing, LLC.
9. MM Systems Corporation.
10. National Sheet Metal Systems, Inc.

B. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:
1. Formed Aluminum: 0.050 inch (1.27 mm) thick.
2. Masonry Type, Embedded: Provide reglets with offset top flange for embedment in masonry mortar joint.

C. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches (100 mm) and in lengths not exceeding 12 feet (3.6 m) designed to snap into reglets or through-wall-flashing receiver and compress against base flashings with joints lapped, from the following exposed metal:
1. Formed Aluminum: 0.024 inch (0.61 mm) thick.

D. Accessories:

1. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.
2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

E. Aluminum Finish: Two-coat fluoropolymer.

1. Color: As selected by Architect from manufacturer's full range.

2.6 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.

C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete roof-specialty systems.

1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
2. Provide uniform, neat seams with minimum exposure of solder and sealant.
3. Install roof specialties to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
4. Torch cutting of roof specialties is not permitted.

5. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.

1. Space movement joints at a maximum of 12 feet (3.6 m) with no joints within 18 inches (450 mm) of corners or intersections unless otherwise shown on Drawings.
2. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

D. Fastener Sizes: Use fasteners of sizes that will penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal joints with elastomeric sealant as required by roofing-specialty manufacturer.

F. Seal joints as required for watertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F (4 deg C).

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm) except reduce pre-tinning where pre-tinned surface would show in completed Work. Tin edges of uncoated copper sheets using solder for copper. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

3.3 COPING INSTALLATION

A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor copings to meet performance requirements.

1. Interlock face and back leg drip edges of snap-on coping cap into cleated anchor plates anchored to substrate at manufacturer's required spacing that meets performance requirements.
2. Interlock face leg drip edge into continuous cleat anchored to substrate at manufacturer's required spacing that meets performance requirements.

3.4 REGLET AND COUNTERFLASHING INSTALLATION

A. General: Coordinate installation of reglets and counterflashings with installation of base flashings.

B. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap 4 inches (100 mm) over top edge of base flashings.

C. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches (100 mm) over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with elastomeric sealant. Fit counterflashings tightly to base flashings.

3.5 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.

D. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077100

SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof hatches.
2. Pipe and duct supports.
3. Preformed flashing sleeves.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for metal vertical ladders, ships' ladders, and stairs for access to roof hatches.
2. Section 055213 "Pipe and Tube Railings" for safety railing systems not attached to roof-hatch curbs.
3. Section 076200 "Sheet Metal Flashing and Trim" for shop- and field-formed metal flashing, roof-drainage systems, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.
4. Section 077100 "Roof Specialties" for manufactured fasciae, copings, gravel stops, gutters and downspouts, and counterflashing.

1.2 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof accessories.

1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

C. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:

1. Size and location of roof accessories specified in this Section.
2. Method of attaching roof accessories to roof or building structure.
3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
4. Required clearances.

B. Sample Warranties: For manufacturer's special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.6 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories to withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

2.2 ROOF HATCHES

A. Roof Hatches: Metal roof-hatch units with lids and insulated curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, and integrally formed deck-mounting flange at perimeter bottom.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. BILCO Company (The).
b. Babcock-Davis.
c. Nystrom, Inc.
d. O'Keeffe's Inc.

B. Type and Size:

1. Single-leaf lid, 30 by 54 inches (750 by 1370 mm).

C. Loads: Minimum 40-lbf/sq. ft. (1.9-kPa) external live load and 20-lbf/sq. ft. (0.95-kPa) internal uplift load.

D. Hatch Material, Steel: Zinc-coated (galvanized) steel sheet.

1. Thickness: Manufacturer's standard thickness for hatch size indicated.
2. Finish: Baked enamel or powder coat.
3. Color: As selected by Architect from manufacturer's full range.

E. Construction:

1. Insulation: 3-inch- thick, polyisocyanurate board.

a. R-Value: 15.0 according to ASTM C1363.

2. Nailer: Factory-installed wood nailer continuous around hatch perimeter.
3. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
4. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
5. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
6. Fabricate curbs to minimum height of 12 inches (305 mm) above roofing surface unless otherwise indicated.
7. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate curb with perimeter curb height that is tapered to accommodate roof slope so that top surfaces of perimeter curb are level. Equip hatch with water diverter or cricket on side that obstructs water flow.

F. Hardware: Spring operators, hold-open arm, galvanized steel spring latch with turn handles, galvanized steel butt- or pintle-type hinge system, and padlock hasps inside and outside.

1. Provide two-point latch on lids larger than 84 inches (2130 mm).

2. Provide remote-control operation.

2.3 PIPE AND DUCT SUPPORTS

A. Fixed-Height Cradle-Type Pipe Supports: Polycarbonate pipe stand accommodating up to 1-1/2-inch- (38-mm-) diameter pipe or conduit; with provision for pipe retainer and with manufacturer's support pad or deck plate as recommended for penetration-free installation over roof membrane type; as required for quantity of pipe runs and sizes.

B. Fixed-Height Roller-Bearing Pipe Supports: Polycarbonate pipe stand with polycarbonate roller carrying assembly accommodating up to 7-inch- (178-mm-) diameter pipe or conduit; with provision for pipe retainer and with manufacturer's support pad or deck plate as recommended for penetration-free installation over roof membrane type; as required for quantity of pipe runs and sizes.

C. Adjustable-Height Structure-Mounted Pipe Supports: Extruded-aluminum tube, filled with urethane insulation; 2 inches (50 mm) in diameter; accommodating up to 7-inch- (178-mm-) diameter pipe or conduit, with provision for pipe retainer; with aluminum baseplate, EPDM base seal, manufacturer's recommended hardware for mounting to structure or structural roof deck as indicated, stainless steel roller and retainer, and extruded-aluminum carrier assemblies; as required for quantity of pipe runs and sizes.

2.4 PREFORMED FLASHING SLEEVES

A. Exhaust Vent Flashing: Double-walled metal flashing sleeve or boot, insulation filled, with integral deck flange, 12 inches (300 mm) high, with removable metal hood and slotted metal collar.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Custom Solution Roof and Metal Products, a division of Colony Heating.
   b. Menzies Metal Products.
   c. Thaler Metal Industries Ltd.

2. Metal: Aluminum sheet, 0.063 inch (1.60 mm) thick.
3. Diameter: As indicated on Drawings.
4. Finish: Manufacturer's standard.

B. Vent Stack Flashing: Metal flashing sleeve, uninsulated, with integral deck flange.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Custom Solution Roof and Metal Products, a division of Colony Heating.
   b. Menzies Metal Products.
   c. Thaler Metal Industries Ltd.

2. Metal: Aluminum sheet, 0.063 inch (1.60 mm) thick.
3. Height: 13 inches (330 mm).
4. Diameter: As indicated on Drawings.
5. Finish: Manufacturer's standard.

2.5 METAL MATERIALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, G90 (Z275) coating designation.

1. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A755/A755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

    a. Two-Coat Fluoropolymer Finish: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight.

2. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils (0.05 mm).
3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil (0.013 mm).

B. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A792M, AZ50 (AZM150) coated.

1. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A755/A755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

    a. Two-Coat Fluoropolymer Finish: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight.

2. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils (0.05 mm).
3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil (0.013 mm).

C. Aluminum Sheet: ASTM B209 (ASTM B209M), manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.

1. Mill Finish: As manufactured.
2. Exposed Coil-Coated Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

a. Two-Coat Fluoropolymer Finish: AAMA 2605. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight.

3. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil (0.013 mm).

D. Aluminum Extrusions and Tubes: ASTM B221 (ASTM B221M), manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise mill finished.

E. Stainless Steel Sheet and Shapes: ASTM A240/A240M or ASTM A666, Type 304.

F. Steel Shapes: ASTM A36/A36M, hot-dip galvanized according to ASTM A123/A123M unless otherwise indicated.

G. Steel Tube: ASTM A500/A500M, round tube.

H. Galvanized-Steel Tube: ASTM A500/A500M, round tube, hot-dip galvanized according to ASTM A123/A123M.

I. Steel Pipe: ASTM A53/A53M, galvanized.

2.6 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Polyisocyanurate Board Insulation: ASTM C1289, thickness and thermal resistivity as indicated.

C. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches (38 mm) thick.

D. Underlayment:

1. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
2. Polyethylene Sheet: 6-mil- (0.15-mm-) thick polyethylene sheet complying with ASTM D4397.
3. Slip Sheet: Building paper, 3 lb/100 sq. ft. (0.16 kg/sq. m) minimum, rosin sized.
4. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

E. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:

1. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A153/A153M or ASTM F2329.
2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
3. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.

F. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.

G. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

H. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.

I. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required for application.

2.7 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

C. Verify dimensions of roof openings for roof accessories.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install roof accessories according to manufacturer's written instructions.

1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.
3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.

C. Roof-Hatch Installation:

1. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
2. Attach safety railing system to roof-hatch curb.
3. Attach ladder-assist post according to manufacturer's written instructions.

D. Pipe Support Installation: Comply with MSS SP-58 and MSS SP-89. Install supports and attachments as required to properly support piping. Arrange for grouping of parallel runs of horizontal piping, and support together.

1. Pipes of Various Sizes: Space supports for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.

E. Preformed Flashing-Sleeve and Flashing-Pipe Portal Installation: Secure flashing sleeve to roof membrane according to flashing-sleeve manufacturer's written instructions; flash sleeve flange to surrounding roof membrane according to roof membrane manufacturer's instructions.

F. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

3.3 REPAIR AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A780/A780M.

B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 099113 "Exterior Painting."

C. Clean exposed surfaces according to manufacturer's written instructions.

D. Clean off excess sealants.

E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077200

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SECTION 077253 SNOW RETENTION BARS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Snow retention bars including non-penetrating fasteners for standing seam metal roofing.

B. Related Work: Coordinate with the following items which are specified in other sections:

1. 133419 – Metal Building Systems

1.2 SUBMITTALS

A. Product Data: For each material and accessory.

B. Shop Drawings: Include layout of snow retention bars and details of installation.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's requirements for delivery, storage and handling.

1.4 WARRANTY

A. Manufacturer's Warranty: Provide manufacturer's standard 20-year limited warranty against product defects.

PART 2 - PRODUCTS

2.1 SNOW RETENTION BARS

A. Basis-of-Design: ColorSnap™ by PMC Industries Inc, telephone 860-351-0686, www.aceclamp.com.

1. Components: Extruded aluminum rail, color strip, ice flags, clamps, top block, hex head bolt, connector link.
2. Extruded Materials (Rails and Ice Flag): 6000 Series tempered aluminum alloy complying with ASTM B221.
3. Stainless Steel Materials (Connector Link and Hex Head Bolts): 300 Series stainless steel complying with ASTM A582/12.
4. Roof Clamp Style: A2, A2N or ML as applicable.
5. Color: Match metal roofing.

PART 3 - PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with manufacturer's requirements for installation. Do not proceed with installation until unsatisfactory conditions have been corrected

3.2 INSTALLATION

A. Install snow retention bars in strict accordance with manufacturer's guidelines and approved submittals. Comply with manufacturer's installation requirements, including the following:

1. Install clamp fully assembled, with non-penetrating fasteners on the standing seam metal ribs. Set extruded bar below the fasteners and slide up until it snaps into place. Tighten bolts on the clips.
2. Insert color-matching metal strip into the bar's front-facing groove.
3. Install aluminum ice flags on the retention system mid-way between the roof seams.

B. Clean snow retention bars after installation. Replace damaged components.

END OF SECTION 077253

SECTION 077600 – PRESSED CONCRETE PAVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provision of contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to work of this Section.

1.2 SUMMARY

A. Work Included This Section:

1. Perform all work required to complete as indicated by the Contract Documents and furnish all supplementary items necessary for the proper installation of Pressed Concrete Pavers.
2. Concrete paver and pedestal support systems, if used, are to be placed over roofing/waterproofing systems where indicated. Standard concrete Paver System to comply with IBC 1504.4 – ANSI/SPRI RP-4 for wind uplift.
3. Standard Concrete paver with Lok Down System to meet ultimate design wind speed of 180 mph per ASCE 7-05 Section 6.6 Method 3 using full-scale wind tests. Full-scale wind tests comply with IBC 1504.4- ANSI/SPRI RP-4 and IBC 1609.1.1.2. Pedestal components are to meet ASTM D635 burn rate category CC2.

B. Related Sections include the following:

1. Section 079200 - Sealants.

1.3 REFERENCES

A. Testing Standards

1. ASTM C-150 - Specification for Portland Cement.
2. ASTM C-127 - Test method for specific gravity and absorption of Course Aggregates.
3. ASTM C-128 - Test method for specific gravity and absorption of Fine Aggregates.
4. ASTM C-136 - Test method for sieve analysis of Fine and Coarse Aggregates.
5. ASTM C-140 - Testing for sampling and testing Concrete masonry and related units.
6. ANSI A326.3 - Dynamic Coefficient of Friction.
7. ASTM C-1028 - Static Coefficient of Friction.
8. ASTM C-1262 - Test Method for Evaluating Freeze-Thaw Durability.
9. WTCL 99 - Load Carrying Capacity.
10. ASTM D638-03 - Standard Test Method for Tensile Properties of Plastics.
11. ASTMD6110-10 - Standard Test Method for Determining the Charpy Impact Resistance of Notched Specimens of Plastics.
12. ASTM G155-05a - Standard practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials.
13. ASTM D1929-96 - Standard Test Method for Determining Ignition Temperature of Plastics.
14. ASTM D2843-99 - Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics.

15. ASTM D635-06 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. All products covered under this Section shall be produced by a single manufacturer, unless otherwise specified, with a minimum of fifteen (15) years proven production of this concrete paver product.

B. Installer Qualifications:
   1. Installer shall have a minimum of five (5) years proven specialized construction experience with this product and be capable of estimating and building from blueprint plans and details, in addition to proper material handling. All work must comply with local, state/provincial licensing and bonding requirements.

1.5 SUBMITTALS

A. Product Data:
   1. Manufacturer's data sheets on each product to be used, including preparation instructions, installation methods, storage, handling requirements and recommendations.
   2. Submit test results for compliance with performance requirements specified herein.
   3. Submit written instructions for recommended maintenance.

B. Shop Drawings:
   1. Layout drawings of each paved area showing the pattern of pressed pavers, indicate pavers requiring cutting, drainage patterns, drains and relationship of paving joints. Include details of setting beds, noting all materials and their thickness, and show details at curbs and vertical surfaces.
   2. Details of custom (nonstandard) curbs and stair tread/risers, include methods of installation.

C. Samples:
   1. Submit sample to be selected by Architect from manufacturer’s available standard and custom colors.

1.6 MOCK-UPS

A. Prior to the start of pressed concrete paver work, construct mock-up of each type of pressed paver size and pattern area for the owner and architect to review. The mock-up will be at the project site or at a location mutually agreed to by the owner and contractor.

   1. Construct the mock-up installation in a minimum 4-foot by 4-foot area of typical concrete units and slabs with all setting beds, joints, edge and curb details as shown on the drawings.
   2. After review of the mock-up, it will be retained and used as a standard of quality for the

pressed concrete paver work. At completion of the work, remove the mock-up installations and related materials from the project site. If the mock-ups are incorporated in the actual construction, record their locations and sizes on the actual built record drawings for the project.

1.7 DELIVERY, STORAGE AND HANDLING

A. In accordance with provisions of Section 01 60 00.

B. Pressed concrete pavers to be banded on pallets and delivered in original unopened packaging with legible manufacturer identification, manufacturing number and manufacture date.

C. Protect pressed concrete pavers during shipment, storage and construction against damage.

1.8 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity and ventilation). Do not install products under adverse environmental conditions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of /Design:

1. Wausau Tile Inc., Estate II pavers.

B. Pressed concrete pavers, equal in appearance and function and meeting these specifications, will be acceptable when the specified submittals from Section 00 26 00 are approved in writing by the Architect prior to bid.

2.2 MATERIAL REQUIREMENTS

A. The pressed paver system shall include the following components:

1. *Portland Cement:* ASTM C-150 specifications for Portland Cement,
2. *Aggregates:* All aggregates are tested in accordance with ASTM C127, ASTM C128, and ASTM C-136 specifications. Aggregate shall be blended to meet individual project requirements.
3. *Coloring:* Pigments used shall be inorganic and alkali resistant and used per manufacturer's recommendations.
4. *Factory Applied Sealer:* Colorless slip and stain resistant penetrating or acrylic sealer.

2.3 PERFORMANCE REQUIREMENTS:

Performance Requirements based on 24"x24"x2" pressed paver

A. H-Series

1. *Compressive Strength:* (ASTM C-140) The average compressive strength shall not be less than 9,500 psi with no individual unit less than 8,000 psi.
2. *Water Absorption:* (ASTM C-140) The average shall not be greater than 4.5 percent.
3. *Flexural Strength:* (ASTM C-140) Shall not be less than 1800 lbs. avg.
4. *Center Load:* (WTCL 99) Pressed paver units shall have a tested center load capacity of 2,000 lbs.
5. *Freeze/Thaw:* (ASTM C-1262) Durability of the pressed paver shall meet the freeze/thaw tests per Section 8, shall have no breakage and not greater than 1 percent loss in dry weight of any individual unit when subject to 100 cycles of freeze/thaw.
6. Dynamic Coefficient of Friction: (ANSI A326.3): Wet: $\geq$ 0.42
7. *Sizing Dimensions:* Shall not differ by more than 1/16 inch (1.6 mm) from width, height, length or thickness. Unit shall conform to a true plane and not differ by more than 1/16 inch (1.6 mm) in either concave and/or convex warpage.

2.4 INSTALLATION MATERIALS:

A. Pedestals and Accessories

1. Terra-Tabs and Shim Plates:

   a. The SBR rubber Terra-Tab units provide spacing tabs, 3/16 inch or 1/8 inch, allowing for drainage and air circulation. Terra-Tabs to have a shore hardness of 70, allowing for resiliency without sound transmission. Terra-Tab sizes to correspond with various sizes of pavers.
   b. Shim Plates are 1/16 inch, 1/8 inch and 1/4 inch thick and of various sizes to correspond with various size Terra-Tabs. Shim Plates to be of the same material as the Terra-Tab.

2. Pedestal Systems:

   a. Terra-Stand Pedestals accommodates various pitches and height changes of the project area. Unit has outside dimension of 7 inches square and provides surface contact of 49 square inches. Unit adjusts from a minimum of 3 inches to a maximum of 21 inches and can tilt to a level plane. Units to be high impact copolymer polypropylene. Terra-Tabs are used on top of this unit.

3. Waffle Reducer:

   a. The Waffle Reducer is made of high impact copolymer polypropylene. Waffle Reducers are made to accommodate height adjustments 3/8 inch to 3 inches. An outside base diameter of 6 inches provides surface contract of 28 square inches. The unit consists of one base with three pieces of 3/8 inch waffle rings and two pieces of 3/4 inch waffle rings.

4. Installation Handles:

   a. Big Blok Handles accommodate paver sizes 24 inches to 36 inches nominal, allowing installing contractor to set units into proper location with 3/16-inch or 1/8-inch joint between units. Also allows for removal and reinstallation without causing any damage to units or adjacent units, thus allowing inspection of utilities or drains at any time.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine all jobsite surfaces to receive the parts of the paving materials. Notify the contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected. Installation of pressed concrete pavers and associated construction constitutes acceptance of the adjacent and underlying construction.

3.2 INSTALLATION OF PEDESTAL PAVER SYSTEM

A. Install in accordance with manufacturer’s instructions:

1. Install in accordance with contributing manufacturer's instructions. Installation requirements vary for each individual project site. Pressed pavers used, pattern, grid layout, starting point and finished elevation should be shown on plan view shop drawings which have been prepared and approved by the designer, installing contractor and/or owner.
2. Inspection of deck and fixed elevation locations. All height or location problems to be corrected before installation.

    a. 60psi minimum insulation or protection board

3. Compare layout of deck to shop drawings or architectural drawings. All variances of field conditions to drawings to be reviewed and corrected prior to starting installation.
4. Set Terra Stand units as a set of grid patterns.
5. Level surface installation using Terra-Stand screw-top pedestal to follow manufacturer’s installation procedures. No variances to system allowed.
6. Terra-Tabs and shim plate are placed, maximum of one shim per location, at intersection of grid line if finished surface is to follow slope of substrates. Paver size centerlines must be adhered to.
7. Minor height and pitch adjustments to pedestal are handled with 1/16-inch rubber shim plates.

B. Placement Tolerance:

1. Maximum of 1/16-inch (1.6 mm) height variation between adjacent pavers.
2. Individual pressed pavers shall not vary more than 1/16 inch (1.6 mm) from level across width of the pressed paver.
3. Paved areas shall not vary more than 1/4 inch (6 mm) in a distance of 10 feet (3 m) measured at any location and in any direction.
4. The surface elevation of pavers shall be 1/8 inch to 1/4 inch (3 mm to 6 mm) above adjacent drainage inlets, concrete collars or channels.
5. Joints between pavers to be greater than 1/16 inch (1.6 mm).

3.3 CLEANING AND PROTECTION

A. Remove and replace pressed pavers which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in same manner as original units with same joint treatment to eliminate evidence of replacement.

B. Wash entire surface with phosphate free neutral cleaner, rinse with clean water and allow to dry thoroughly.

C. Apply sealer in accordance with manufacturer's directions.

1. Penetrating or topical type sealer designed especially for pressed concrete pavers.

END OF SECTION 075550

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls.

B. Related Sections:

1. Section 078446 "Fire-Resistive Joint Systems" for joints in or between fire-resistance-rated construction.

1.3 ACTION SUBMITTALS

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

B. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.

1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for penetration firestopping.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

B. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:

1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:

a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
b. Classification markings on penetration firestopping correspond to designations listed by the following:

1) UL in its "Fire Resistance Directory."

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.

C. Notify Owner's testing agency at least seven days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. A/D Fire Protection Systems Inc.
2. Grace Construction Products.
3. Hilti, Inc.
4. Johns Manville.
5. Nelson Firestop Products.
6. NUCO Inc.
7. Passive Fire Protection Partners.
8. RectorSeal Corporation.
9. Specified Technologies Inc.
10. 3M Fire Protection Products.
11. Tremco, Inc.; Tremco Fire Protection Systems Group.
12. USG Corporation.

2.2 PENETRATION FIRESTOPPING

A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).

1. Fire-resistance-rated walls include fire-barrier walls.
2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. W-Rating: Provide penetration firestopping showing no evidence of water leakage when tested according to UL 1479.

D. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

E. VOC Content: Penetration firestopping sealants and sealant primers shall 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.

F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.

1. Permanent forming/damming/backing materials, including the following:

a. Slag-wool-fiber or rock-wool-fiber insulation.
b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
c. Fire-rated form board.
d. Fillers for sealants.

2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

2.3 FILL MATERIALS

A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.

E. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of nonsag grade for both opening conditions.

2.4 MIXING

A. For those products requiring mixing before application, comply with penetration firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

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

C. Install fill materials for firestopping by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections.

B. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.

C. Proceed with enclosing penetration firestopping with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

END OF SECTION 078413

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SECTION 078446 - FIRE-RESISTIVE JOINT SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Joints in or between fire-resistance-rated constructions.

B. Related Sections:

1. Section 078413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls.

1.3 ACTION SUBMITTALS

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

B. Product Schedule: For each fire-resistive joint system. Include location and design designation of qualified testing agency.

1. Where Project conditions require modification to a qualified testing agency's illustration for a particular fire-resistive joint system condition, submit illustration, with modifications marked, approved by fire-resistive joint system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Installer Certificates: From Installer indicating fire-resistive joint systems have been installed in compliance with requirements and manufacturer's written recommendations.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fire-resistive joint systems.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

B. Installer Qualifications: A firm experienced in installing fire-resistive joint systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its fire-resistive joint system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

C. Fire-Test-Response Characteristics: Fire-resistive joint systems shall comply with the following requirements:

1. Fire-resistive joint system tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
2. Fire-resistive joint systems are identical to those tested per testing standard referenced in "Fire-Resistive Joint Systems" Article. Provide rated systems complying with the following requirements:

    a. Fire-resistive joint system products bear classification marking of qualified testing agency.
    b. Fire-resistive joint systems correspond to those indicated by reference to designations listed by the following:

        1) UL in its "Fire Resistance Directory."

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Install and cure fire-resistive joint systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.

B. Coordinate sizing of joints to accommodate fire-resistive joint systems.

C. Notify Owner's testing agency at least seven days in advance of fire-resistive joint system installations; confirm dates and times on day preceding each series of installations.

PART 2 - PRODUCTS

2.1 FIRE-RESISTIVE JOINT SYSTEMS

A. Where required, provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which fire-resistive joint systems are installed. Fire-resistive joint systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

B. Joints in or between Fire-Resistance-Rated Construction: Provide fire-resistive joint systems with ratings determined per ASTM E 1966 or UL 2079:

1. Joints include those installed in or between fire-resistance-rated walls.
2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of construction they will join.
3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. A/D Fire Protection Systems Inc.
b. CEMCO.
c. Fire Trak Corp.
d. Grace Construction Products.
e. Hilti, Inc.
f. Johns Manville.
g. Nelson Firestop Products.
h. NUCO Inc.
i. Passive Fire Protection Partners.
j. RectorSeal Corporation.
k. Specified Technologies Inc.
l. 3M Fire Protection Products.
m. Tremco, Inc.; Tremco Fire Protection Systems Group.
n. USG Corporation.

C. Exposed Fire-Resistive Joint Systems: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

D. VOC Content: Fire-resistive joint system sealants shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

E. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to maintain ratings required. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing agency for systems indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:

1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates.

3.3 INSTALLATION

A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.

2. Apply fill materials so they contact and adhere to substrates formed by joints.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Identify fire-resistive joint systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of joint edge so labels will be visible to anyone seeking to remove or penetrate joint system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Fire-Resistive Joint System - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Where deficiencies are found or fire-resistive joint systems are damaged or removed due to testing, repair or replace fire-resistive joint systems so they comply with requirements.

C. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which joints occur.

B. Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

END OF SECTION 078446

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SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Acoustical joint sealants.
4. Mildew-resistant joint sealants.

B. Related Requirements:

1. Section 042000 "Unit Masonry" for masonry control and expansion joint fillers and gaskets.
2. Section 078446 "Fire-Resistive Joint Systems" for sealing joints in fire-resistance-rated construction.
3. Section 092900 "Gypsum Board" for sealing perimeter joints.
4. Section 093013 "Ceramic Tiling" for sealing tile joints.

1.3 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

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.

C. Samples for Verification: For each kind 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.

D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.

C. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.

D. Product Test Reports: For each kind of joint sealant, for tests performed by a qualified testing agency.

E. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming 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.

F. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

G. Field-Adhesion-Test Reports: For each sealant application tested.

H. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

C. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

2. Test 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.

D. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.6 FIELD 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.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace 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 agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from 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

2.1 JOINT SEALANTS, 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 joint-sealant manufacturer, based on testing and field experience.

B. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following:

1. Architectural sealants shall have a VOC content of 250 g/L or less.
2. Sealants and sealant primers for nonporous substrates shall have a VOC content of 250 g/L or less.

3. Sealants and sealant primers for nonporous substrates shall have a VOC content of 775 g/L or less.

C. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
1. Suitability for Immersion in Liquids: Where sealants are indicated for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.

D. Stain-Test-Response Characteristics: Where sealants are specified to be non-staining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

E. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

F. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

A. Silicone, Acid Curing, S, NS, 25, NT: Single-component, nonsag, acid-curing silicone joint sealant: ASTM C 920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Bostik, Inc.
b. Dow Corning Corporation.
c. May National Associates, Inc.; a subsidiary of Sika Corporation.
d. Pecora Corporation.
e. Polymeric Systems, Inc.

2.3 URETHANE JOINT SEALANTS

A. Urethane, S, NS, 25, NT: Single-component, nonsag, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. BASF Corporation; Construction Systems.
b. Bostik, Inc.
c. Pecora Corporation.
d. Polymeric Systems, Inc.
e. Schnee-Morehead, Inc., an ITW company.

f. Sika Corporation; Joint Sealants.
g. Tremco Incorporated.

2.4 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. BASF Building Systems; Omniplus.
b. Dow Corning Corporation.
c. GE Construction Sealants; Momentive Performance Materials Inc.
d. May National Associates, Inc.; a subsidiary of Sika Corporation.
e. Tremco Incorporated.

2.5 ACOUSTICAL JOINT SEALANTS

A. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, non-staining latex sealant complying with ASTM C 834. 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.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Pecora Corporation
b. USG Corporation.

2.6 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Non-staining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. BASF Corporation; Construction Systems.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), Type O (open-cell material), Type B (bicellular material with a surface skin), or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application

indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. 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. Provide self-adhesive tape where applicable.

2.7 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

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

PART 3 - EXECUTION

3.1 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 performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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, 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.
d. Exterior insulation and finish systems.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

a. Metal.
b. Glass.
c. Porcelain enamel.
d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 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. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

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 profile per Figure 8A in ASTM C 1193 unless otherwise indicated.
4. Provide flush joint profile at locations indicated according to Figure 8B in ASTM C 1193.
5. Provide recessed joint configuration of recess depth and at locations indicated according to Figure 8C in ASTM C 1193.

a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

G. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:

a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.
b. Perform one test for each 1000 feet (300 m) of joint length thereafter or one test per each floor per elevation.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

3. Inspect tested joints and report on the following:

a. Whether sealants filled joint cavities and are free of voids.
b. Whether sealant dimensions and configurations comply with specified requirements.
c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.

4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
5. 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-Adhesion-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.

3.5 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.

3.6 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, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 079200

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SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior standard steel doors and frames.
2. Exterior standard steel doors and frames.

B. Related Requirements:

1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

1.2 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings in accordance with NAAMM-HMMA 803 or ANSI/SDI A250.8.

1.3 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Interior standard steel doors and frames.
2. Exterior standard steel doors and frames.

B. Product Data Submittals: For each product.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.

C. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.

4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
7. Details of anchorages, joints, field splices, and connections.
8. Details of accessories.
9. Details of moldings, removable stops, and glazing.

D. Samples for Verification:

1. Finishes: For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches (75 by 127 mm).

E. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For door inspector.

1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.

B. Product Test Reports: For each type of fire-rated hollow-metal door and frame assembly fire-rated borrowed-lite assembly and thermally rated door assemblies for tests performed by a qualified testing agency indicating compliance with performance requirements.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.7 QUALITY ASSURANCE

A. Fire-Rated Door Inspector Qualifications: Inspector for field quality-control inspections of fire-rated door assemblies is to meet the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 HOLLOW METAL DOORS AND FRAMES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Ceco Door; AADG, Inc.; ASSA ABLOY.
2. Curries, AADG, Inc.; ASSA ABLOY Group.
3. LaForce, LLC.
4. Mesker Door; Mesker Openings Group.
5. Republic Doors and Frames; a Allegion brand.
6. Steelcraft; Allegion plc.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.

B. Fire-Rated, Borrowed-Lite Assemblies: Assemblies complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing in accordance with NFPA 257 or UL 9.

2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B..

1. Doors:

a. Type: As indicated in the Door and Frame Schedule on Drawings.

b. Thickness: 1-3/4 inches (44.5 mm).
c. Face: Uncoated steel sheet, minimum thickness of 0.042 inch (1.0 mm).
d. Edge Construction: Model 1, Full Flush.
e. Core: Manufacturer's standard.
f. Fire-Rated Core: Manufacturer's standard core for fire-rated doors.

2. Frames:

a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
c. Construction: Full profile welded.

3. Exposed Finish: Prime.

2.4 EXTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B..

1. Doors:

a. Type: As indicated in the Door and Frame Schedule on Drawings.
b. Thickness: 1-3/4 inches (44.5 mm).
c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch (1.0 mm), with minimum A40 (ZF120) coating.
d. Edge Construction: Model 1, Full Flush.
e. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
f. Bottom Edges: Close bottom edges of doors with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
g. Core: Polystyrene.

2. Frames:

a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.
b. Construction: Full profile welded, Thermally-broken frame.

3. Exposed Finish: Prime.

2.5 BORROWED LITES

A. Fabricate of uncoated steel sheet, minimum thickness of 0.042 inch (1.0 mm).

B. Construction: Full profile welded.

C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.

D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.6 HOLLOW-METAL PANELS

A. Provide hollow-metal panels of same materials, construction, and finish as adjacent door assemblies.

2.7 FRAME ANCHORS

A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches (610 mm) of frame height above 7 feet (2.1 m).
3. Postinstalled Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at top of underlayment.

D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.

2.8 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.

E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

F. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

G. Glazing: Comply with requirements in Section 088000 "Glazing."

2.9 FABRICATION

A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with ANSI/SDI A250.6, the Door Hardware Schedule on Drawings, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Provide stops and moldings flush with face of door, and with beveled stops unless otherwise indicated.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.

3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

2.10 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.11 LOUVERS

A. Provide louvers for interior doors, where indicated, which comply with SDI 111, with blades or baffles formed of 0.020-inch- (0.5-mm-) thick, cold-rolled steel sheet set into 0.032-inch- (0.8-mm-) thick steel frame.

1. Sightproof Louver: Stationary louvers constructed with inverted-V or inverted-Y blades.

B. Form corners of moldings with hairline joints. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.

B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11 or NAAMM-HMMA 840.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.

    a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
    b. Install frames with removable stops located on secure side of opening.

2. Fire-Rated Openings: Install frames in accordance with NFPA 80.
3. Floor Anchors: Secure with postinstalled expansion anchors.

    a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

4. Solidly pack mineral-fiber insulation inside frames.
5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.

1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8 or NAAMM-HMMA 841 and NAAMM-HMMA guide specification indicated.
2. Fire-Rated Doors: Install doors with clearances in accordance with NFPA 80.
3. Smoke-Control Doors: Install doors in accordance with NFPA 105.

D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.

B. Inspections:

1. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 REPAIR

A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint in accordance with manufacturer's written instructions.

C. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish in accordance with manufacturer's written instructions.

D. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

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SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Solid-core doors with wood-veneer faces.
2. Factory finishing flush wood doors.

B. Related Requirements:
1. Section 088000 "Glazing" for glass view panels in flush wood doors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of door. Include details of core and edge construction, louvers, and trim for openings. Include factory-finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:

1. Dimensions and locations of blocking.
2. Dimensions and locations of mortises and holes for hardware.
3. Dimensions and locations of cutouts.
4. Undercuts.
5. Requirements for veneer matching.
6. Doors to be factory finished and finish requirements.
7. Fire-protection ratings for fire-rated doors.

C. Samples for Initial Selection: For factory-finished doors.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in plastic bags or cardboard cartons.

C. Mark each door on bottom rail with opening number used on Shop Drawings.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 25 and 55 percent during remainder of construction period.

1.6 WARRANTY

A. A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Warping (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section.
b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 76.2-mm) span.

2. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABS- American Building Supply- Doormerica.
2. Algoma Hardwoods, Inc.
3. Ampco Products, LLC.
4. Chappell Door Co.
5. Eggers Industries.
6. General Veneer Manufacturing Co.
7. Graham Wood Doors; ASSA ABLOY Group Company.
8. Haley Brothers, Inc.
9. Ipik Door Company.
10. Lambton Doors.
11. Marlite.
12. Marshfield DoorSystems, Inc.
13. Mohawk Flush Doors, Inc.
14. Oregon Door.
15. Oshkosh Door Company.
16. Poncraft Door Company.
17. Vancouver Door Company.
18. VT Industries Inc.

B. Source Limitations: Obtain flush wood doors from single manufacturer.

2.2 FLUSH WOOD DOORS, GENERAL

A. Quality Standard: In addition to requirements specified, comply with AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."

1. Provide AWI Quality Certification Labels indicating that doors comply with requirements of grades specified.

B. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.

C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
2. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
3. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
4. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
5. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.

D. Particleboard-Core Doors:

1. Particleboard: ANSI A208.1, Grade LD-1 or Grade LD-2, made with binder containing no urea-formaldehyde.

E. Mineral-Core Doors:

1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as needed to eliminate through-bolting hardware.
3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

a. Screw-Holding Capability: 475 lbf (2110 N per WDMA T.M.-10.

F. Interior Solid-Core Doors:

1. Grade: Premium, with Grade A faces.
2. Species: Match VT Industries, Select White Birch, Color: Riverstone RI18

3. Cut: Rotary cut.
4. Match between Veneer Leaves: Book match.
5. Assembly of Veneer Leaves on Door Faces: Center-balance match.
6. Pair and Set Match: Provide for doors hung in same opening.
7. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
8. Exposed Vertical Edges: Same species as faces or a compatible species - edge Type A.
9. Core: Particleboard.
10. Construction: Five or seven plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering. Faces are bonded to core using a hot press.
11. WDMA I.S.1-A Performance Grade: Heavy Duty.

2.3 LIGHT FRAMES AND LOUVERS

A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.

1. Wood Species: Same species as door faces.
2. Profile: Manufacturer's standard shape.
3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

B. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

C. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch- (1.2-mm-) thick, cold-rolled steel sheet; [factory primed for paint] [with baked-enamel- or powder-coated] finish; and approved for use in doors of fire-protection rating indicated.

2.4 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

1. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.

1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.

C. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.

2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."

2.5 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Factory finish doors.

C. Transparent Finish:

1. Grade: Premium.
2. Finish: WDMA TR-6 catalyzed polyurethane.
3. Staining: Match VT Industries Architectural Wood Doors, Ravine RA18.
4. Effect: Open-grain finish.
5. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Section 087100 "Door Hardware."

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

1. Install fire-rated doors according to NFPA 80.

C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.

1. Clearances: Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide1/4 inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated.

    a. Comply with NFPA 80 for fire-rated doors.
    b. 2. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.

2. Bevel fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock edge; trim stiles and rails only to extent permitted by labeling agency.

D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Access doors and frames.

B. Related Requirements:

1. Section 077200 "Roof Accessories" for roof hatches.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples: For each type of access door and frame and for each finish specified, complete assembly minimum 6 by 6 inches (150 by 150 mm) in size.

C. Product Schedule: For access doors and frames.

1.3 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of applicable room name and number in which access door is located.

PART 2 - PRODUCTS

2.1 ACCESS DOORS AND FRAMES

A. Flush Access Doors with Concealed Flanges:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. ACUDOR Products, Inc.
b. Babcock-Davis.
c. JL Industries; Activar Construction Products Group, Inc.
d. Nystrom, Inc.

2. Description: Face of door flush with frame; with concealed flange for gypsum board installation and concealed hinge.
3. Locations: Wall and ceiling.
4. Uncoated Steel Sheet for Door: Nominal 0.060 inch (1.52 mm), 16 gage, factory primed.
5. Frame Material: Same material and thickness as door.
6. Latch and Lock: Cam latch, screwdriver operated.

2.2 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.

C. Frame Anchors: Same material as door face.

D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.3 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.

1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.

D. Latch and Lock Hardware:

1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.

2.4 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 FIELD QUALITY CONTROL

A. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

B. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.4 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 083113

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SECTION 083313 - COILING COUNTER DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Counter door assemblies.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for door-opening framing and corner guards.

1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of coiling counter door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
4. Show locations of controls, locking devices, and other accessories.

C. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:

1. Curtain slats.
2. Bottom bar.
3. Guides.
4. Brackets.
5. Hood.
6. Locking device(s).
7. Include similar Samples of accessories involving color selection.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For coiling counter doors to include in maintenance manuals.

B. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain coiling counter doors from single source from single manufacturer.

1. Obtain operators and controls from coiling counter door manufacturer.

2.2 COUNTER DOOR ASSEMBLY

A. Counter Door: Coiling counter door formed with curtain of interlocking metal slats.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Cornell; a CornellCookson company.

B. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

C. Door Curtain Material: Aluminum.

D. Door Curtain Slats: Flat profile slats of 1-1/2-inch (38-mm) center-to-center height.

E. Bottom Bar: Manufacturer's standard continuous channel or tubular shape, fabricated aluminum extrusion and finished to match door.

F. Curtain Jamb Guides: Aluminum with exposed finish matching curtain slats.

G. Hood: Match curtain material and finish.

1. Shape: Square.
2. Mounting: Face of wall.

H. Locking Devices: Equip door with locking device assembly.

1. Locking Device Assembly: Single-jamb side locking bars, operable from inside with thumbturn.

I. Manual Door Operator: Push-up operation.

J. Curtain Accessories: Equip door with push/pull handles.

K. Door Finish:

1. Aluminum Finish: Anodized color as selected by Architect from full range of industry colors and color densities.
2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.3 DOOR CURTAIN MATERIALS AND FABRICATION

A. Door Curtains: Fabricate coiling counter door curtain of interlocking metal slats in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Aluminum Door Curtain Slats: ASTM B209 (ASTM B209M) sheet or ASTM B221 (ASTM B221M) extrusions, alloy and temper standard with manufacturer for type of use and finish indicated; thickness of 0.050 inch (1.27 mm); and as required.
2. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face.

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

2.4 HOODS

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Aluminum: 0.040-inch- (1.02-mm-) thick aluminum sheet complying with ASTM B209 (ASTM B209M), of alloy and temper recommended by manufacturer and finisher for type of use and finish indicated.

2.5 LOCKING DEVICES

A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

2.6 CURTAIN ACCESSORIES

A. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.

B. Pull-Down Strap: Provide pull-down straps for doors more than 84 inches (2130 mm) high.

2.7 COUNTERBALANCE MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless or welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. (2.5 mm/m) of span under full load.

C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.8 MANUAL DOOR OPERATORS

A. General: Equip door with manual door operator by door manufacturer.

B. Push-up Door Operation: Design counterbalance mechanism so that required lift or pull for door operation does not exceed 25 lbf (111 N).

2.9 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.10 ALUMINUM FINISHES

A. Baked-Enamel or Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install coiling counter doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Install coiling counter doors, hoods, controls, and operators at the mounting locations indicated for each door.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and to furnish reports to Architect.

B. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

C. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.4 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain coiling counter doors.

END OF SECTION 083313

SECTION 083613 - SECTIONAL DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Sectional-door assemblies.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.

1.3 ACTION SUBMITTALS

A. Product Data: For each type and size of sectional door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.
2. For power-operated doors, include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

B. Shop Drawings: For each installation and for components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
4. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard size.

D. Samples for Initial Selection: For units with factory-applied finishes.

1. Include Samples of accessories involving color selection.

E. Samples for Verification: For each type of exposed finish and for each color and texture required on the following components, in manufacturer's standard sizes:

1. Glazing.
2. Metal for door sections.
3. Hardware.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranties: For manufacturer's warranty and finish warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sectional doors to include in maintenance manuals.

B. Manufacturer's warranty.

C. Finish warranty.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

B. Regulatory Requirements: Comply with provisions in the U.S. Department of Justice's "2010 ADA Standards for Accessible Design" and ICC A117.1 applicable to sectional doors.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Failure of components or operators before reaching required number of operation cycles.
c. Faulty operation of hardware.
d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.
e. Delamination of exterior or interior facing materials.

2. Warranty Period: One year from date of Substantial Completion.

B. Finish Warranty: Manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

A. Source Limitations: Obtain sectional doors from single source from single manufacturer.

1. Obtain operators and controls from sectional door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Provide sectional doors that comply with performance requirements specified without failure from defective manufacture, fabrication, installation, or other defects in construction and without requiring temporary installation of reinforcing components.

B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.

1. Design Wind Load: Uniform pressure (velocity pressure) of 20 lbf/sq. ft. (960 Pa), acting inward and outward.
2. Testing: In accordance with ASTM E330/E330M or DASMA 108 for garage doors and complying with DASMA 108 acceptance criteria.
3. Deflection Limits: Design sectional doors to withstand design wind loads without evidencing permanent deformation or disengagement of door components.

a. Deflection of door sections in horizontal position (open) shall not exceed 1/120 of door width.
b. Deflection of horizontal track assembly shall not exceed 1/240 of door height.

2.3 SECTIONAL-DOOR ASSEMBLY

A. Steel Sectional Door: Provide sectional door formed with hinged sections and fabricated so that finished door assembly is rigid and aligned with tight hairline joints; free of warp, twist, and deformation; and complies with requirements in DASMA 102.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Clopay Building Products.
1) Basis of Design: Clopay, Extreme Series High Performance, Insulated Steel

B. Operation Cycles: Door components and operators capable of operating for not less than 20,000 operation cycles. One operation cycle is complete when door is opened from closed position to the open position and returned to closed position.

C. Air Infiltration: Maximum rate of 0.4 cfm/sq. ft. (2.03 L/s per sq. m) when tested in accordance with ASTM E283 or DASMA 105.

D. U-Value: Minimum tested and verified U-Value 0.125.

E. Steel Door Sections: ASTM A653/A653M, zinc-coated (galvanized), cold-rolled, commercial steel sheet with G60 (Z180) zinc coating.

1. Door-Section Thickness: 2 inches (51 mm).
2. Section Faces:

a. Thermal-Break Construction: Provide sections with continuous thermal-break construction separating the exterior and interior faces of door.
b. Exterior Face: Fabricated from single sheets, not more than 24 inches (610 mm) high; with horizontal meeting edges rolled to continuous, interlocking, keyed, rabbeted, shiplap, or tongue-in-groove, weather- and pinch-resistant seals and reinforcing flange return.

1) Steel Sheet Thickness: 0.019-inch (0.48-mm) nominal coated thickness.
2) Surface: Manufacturer's standard, ribbed.

c. Interior Face: Enclose insulation completely within steel exterior facing and interior facing material, with no exposed insulation. Provide the following interior-facing material:

1) Zinc-Coated (Galvanized) Steel Sheet: With minimum nominal coated thickness of 0.019 inch (0.48 mm).

3. End Stiles: Enclose open ends of sections with channel end stiles formed from galvanized-steel sheet not less than 0.040-inch (1.02-mm) nominal coated thickness and welded to door section.
4. Section Reinforcing: Horizontal and diagonal reinforcement as required to stiffen door and for wind loading. Provide galvanized-steel bars, struts, trusses, or strip steel, formed to depth and bolted or welded in place. Ensure that reinforcement does not obstruct vision lites.

a. Bottom Section: Reinforce section with a continuous channel or angle conforming to bottom-section profile and allowing installation of astragal (weatherseal).
b. Hardware Locations: Provide reinforcement for hardware attachment.

5. Thermal Insulation: Insulate interior of steel sections with door manufacturer's standard CFC-free insulation of type indicated below:

a. Board Insulation: Polystyrene or polyurethane, secured to exterior face sheet.
b. Foamed-in-Place Insulation: Polyurethane, foamed in place to completely fill interior of section and pressure bonded to face sheets to prevent delamination under wind load.
c. Fire-Resistance Characteristics: Maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, in accordance with ASTM E84.

F. Track: Manufacturer's standard, galvanized-steel, high-lift track system. Provide complete system including brackets, bracing, and reinforcement to ensure rigid support of ball-bearing roller guides.

1. Material: Galvanized steel, ASTM A653/A653M, minimum G60 (Z180) zinc coating.

2. Size: As recommended in writing by manufacturer for door size, weight, track configuration and door clearances indicated on Drawings.
3. Track Reinforcement and Supports: Provide galvanized-steel members to support track without sag, sway, and vibration during opening and closing of doors. Slot vertical sections of track spaced 2 inches (51 mm) apart for door-drop safety device.

G. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom, top and jambs of door.

H. Windows: Manufacturer's standard window units of shape and size and in locations indicated on Drawings. Set glazing in vinyl, rubber, or neoprene glazing channel. Provide removable stops of same material as door-section frames. Provide the following glazing:
1. Insulating Glass Units: Manufacturer's standard.

I. Hardware: Heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless steel, or other corrosion-resistant fasteners, to suit door type.

1. Hinges: Heavy-duty, galvanized-steel hinges of not less than 0.079-inch (2.01-mm) nominal coated thickness at each end stile and at each intermediate stile, in accordance with manufacturer's written recommendations for door size.

a. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is impossible.
b. Provide double-end hinges where required for doors more than 16 ft. (4.88 m) wide unless otherwise recommended by door manufacturer in writing.

2. Rollers: Heavy-duty rollers with steel ball bearings in case-hardened steel races, mounted to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Match roller-tire diameter to track width.

a. Roller-Tire Material: Manufacturer's standard.

3. Push/Pull Handles: Equip each door with galvanized-steel lifting handles on each side of door, finished to match door.

J. Locking Device:

1. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on single-jamb side, operable from inside only.
2. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

K. Counterbalance Mechanism:

1. Torsion Spring: Adjustable-tension torsion springs complying with requirements of DASMA 102 for number of operation cycles indicated, mounted on torsion shaft.
2. Cable Drums and Shaft for Doors: Cast-aluminum cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised.

a. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft.
b. Provide one additional midpoint bracket for shafts up to 16 ft. (4.88 m) long and two additional brackets at one-third points to support shafts more than 16 ft. (4.88 m) long unless closer spacing is recommended in writing by door manufacturer.

3. Cables: Galvanized-steel, multistrand, lifting cables with cable safety factor of at least 5 to 1.
4. Cable Safety Device: Include a spring-loaded steel or bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if lifting cable breaks.
5. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.
6. Bumper: Provide spring bumper at each horizontal track to cushion door at end of opening operation.

L. Electric Door Operator: Electric door operator assembly of size and capacity recommended by door manufacturer for door and operation cycles specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Comply with NFPA 70.
2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6; with NFPA 70, Class 2 control circuit, maximum 24 V ac or dc.
3. Safety: Listed in accordance with UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 ft. (2.4 m) or lower.
4. Usage Classification: Heavy duty, 25 or more cycles per hour and more than 90 cycles per day.
5. Operator Type: Jackshaft, side mounted.
6. Motor: Reversible-type with controller (disconnect switch) for interior, clean, and dry motor exposure. Use adjustable motor-mounting bases for belt-driven operators.

a. Motor Size: 1 hp (746 W).
b. Electrical Characteristics:

1) Phase: Polyphase.
2) Volts: 208 V.

7. Limit Switches: Equip motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
8. Obstruction Detection: Automatic external entrapment protection consisting of automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.

9. Control Station: Surface mounted, three-position (open, close, and stop) control.

a. Operation: Push button.

b. Interior-Mounted Unit: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
c. Features: Provide the following:

1) Vehicle detection operation.
2) Radio-control operation.
3) Photocell operation.
4) Door-timer operation.
5) Explosion- and dust-ignition-proof control wiring.
6) Audible and visual signals that comply with regulatory requirements for accessibility.

10. Emergency Manual Operation: Chain type designed so required force for door operation does not exceed 25 lbf (111 N).
11. Emergency Operation Disconnect Device: Hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
12. Motor Removal: Design operator so motor can be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

M. Metal Finish: Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.
1. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; in accordance with manufacturer's written instructions.

B. Tracks:

1. Fasten vertical track assembly to opening jambs and framing with fasteners spaced not more than 24 inches (610 mm) apart.

2. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.

C. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

D. Power-Operated Doors: Install in accordance with UL 325.

3.3 STARTUP SERVICES

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's written instructions.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust doors and seals to provide weather-resistant fit around entire perimeter.

D. Touchup Painting Galvanized Material: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A780/A780M.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

END OF SECTION 083613

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum-framed entrance and storefront systems.

B. Related Requirements:

1. Section 084126 "All-Glass Entrances and Storefronts" for systems without aluminum support framing.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Aluminum-framed entrance and storefront systems.

B. Product Data Submittals: For each product.

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories.

C. Shop Drawings:

1. Plans, elevations, sections, full-size details, and attachments to other work.
2. Details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
3. Full-size isometric details of each type of vertical-to-horizontal intersection of aluminum-framed entrance and storefront systems, showing the following:

    a. Joinery, including concealed welds.
    b. Anchorage.
    c. Expansion provisions.
    d. Glazing.
    e. Flashing and drainage.

4. Connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
5. Point-to-point wiring diagrams showing the following:

    a. Power requirements for each electrically operated door hardware.
    b. Location and types of switches, signal device, conduit sizes, and number and size of wires.

6. Signed and sealed by the qualified professional engineer responsible for their preparation.

D. Samples for Verification: Actual sample of finished products for each type of exposed finish.

1. Size: Manufacturers' standard size.

E. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. 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.

1.3 INFORMATIONAL SUBMITTALS

A. Energy Performance Certificates: For aluminum-framed entrance and storefront systems, accessories, and components, from manufacturer.

1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront system.

B. Product Test Reports: For aluminum-framed entrance and storefront systems, for tests performed by manufacturer and witnessed by a qualified testing agency.

C. Source Quality-Control Reports: For aluminum-framed entrance and storefront systems.

D. Field Quality-Control Reports: For aluminum-framed entrance and storefront systems.

E. Qualification Statements:

1. For Installer and field testing agency .

F. Sample Warranties: For aluminum-framed entrance and storefront systems.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For aluminum-framed entrance and storefront systems.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. Entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.6 MOCKUPS

A. Build mockups to set quality standards for materials and execution and to set quality standards for fabrication and installation.

1. Build mockup.
2. Testing to be performed on mockups in accordance with requirements in "Field Quality Control" Article.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrance and storefront systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including but not limited to excessive deflection.
b. Noise or vibration created by wind and thermal and structural movements.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
d. Water penetration through fixed glazing and framing areas.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Aluminum-framed storefront system shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:

1. Design Wind Loads: Determine design wind loads applicable to the Project from basic wind speed indicated in miles per hour, according to ASCE 7-05, Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Drawings.

a. Basic Wind Speed (MPH): 90 mph
b. Importance Factor (I, II, III, IV): IV
c. Exposure Category (A, B, C, D): C

B. Storefront System Performance Requirements:

1. Wind loads: Provide storefront system; include anchorage, capable of withstanding wind load design pressures of (20.3) lbs./sq. ft. inward and (27.2) lbs./sq. ft. outward. The design pressures are based on the (International) Building Code; (2009) Edition.

2. Air Infiltration: The test specimen shall be tested in accordance with ASTM E 283. Air infiltration rate shall not exceed 0.06 cfm/ft^2 (0.3 l/s · m^2) at a static air pressure differential of 6.24 psf (300 Pa) with interior seal, or, rate shall not exceed 0.06 cfm/ft^2 (0.3 l/s · m^2) at a static air pressure differential of 1.57 psf (75 Pa) without interior seal. CSA A440 Fixed Rating.

3. Air Exfiltration: The test specimen shall be tested in accordance with ASTM E 283. Air exfiltration rate shall not exceed 0.045 cfm/ft of crack (0.25 l/s · m of crack) at a static air pressure differential of 1.57 psf (75 Pa). CSA A440 Fixed Rating.

4. Water Resistance: The test specimen shall be tested in accordance with ASTM E 331. There shall be no leakage at a minimum static air pressure differential of 10 psf (500 Pa) as defined in AAMA 501. CSA A440 B5 Rating.

5. Uniform Load: A static air design load of 30 psf (1437 Pa) shall be applied in the positive and negative direction in accordance with ASTM E 330. There shall be no deflection in excess of L/175 of the span of any framing member. At a structural test load equal to 1.5 times the specified design load, no glass breakage or permanent set in the framing members in excess of 0.2% of their clear spans shall occur. CSA A440 C2 Rating.

6. Thermal Transmittance (U-factor): When tested to AAMA Specification 1503, the thermal transmittance (U-factor) shall not be more than: – 0.35 (low-e).

7. Condensation Resistance (CRF): When tested to AAMA Specification 1503, the condensation resistance factor shall not be less than: 69 frame and 70 glass (low-e).

8. Condensation Resistance (I): When tested to CSA A-440.2, the condensation index shall not be less than: 63 frame and 68 glass (low-e).

9. Sound Transmission Class (STC) and Outdoor-Indoor Transmission Class (OITC): When tested to AAMA Specification 1801 and in accordance with ASTM E1425 and ASTM E90, the STC and OITC Rating shall not be less than: 37 (STC) and 31 (OITC)

2.3 ALUMINUM-FRAMED ENTRANCE AND STOREFRONT SYSTEMS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. EFCO Corporation.
2. Kawneer Company, Inc.; Arconic Corporation.
3. Manko Window Systems, Inc.
4. Tubelite Inc.

B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Exterior Framing Construction: Thermally broken.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Center.
4. Finish: Baked-enamel or powder-coat finish.
5. Fabrication Method: Field-fabricated stick system.
6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
7. Steel Reinforcement: As required by manufacturer.

C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

E. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.

1. Door Construction: 1-3/4-inch (44.5-mm) overall thickness, with minimum 0.125-inch-(3.2-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.

   a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.

2. Door Design: Medium stile; 3-1/2-inch (88.9-mm) nominal width.

3. Glazing Stops and Gaskets: Snap-on, extruded-aluminum stops and preformed gaskets.
4. Finish: Match adjacent storefront framing finish.

2.4 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

2.5 MATERIALS

A. Sheet and Plate: ASTM B209 (ASTM B209M).

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).

C. Structural Profiles: ASTM B308/B308M.

D. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

E. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

2.6 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.

C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

E. Rigid PVC filler.

2.7 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from exterior.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

C. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

D. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

1. At interior and exterior doors, provide compression weather stripping at fixed stops.

E. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

F. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

G. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.8 ALUMINUM FINISHES

A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF ALUMINUM-FRAMED ENTRANCE AND STOREFRONT SYSTEMS

A. Comply with manufacturer's written instructions.

B. Do not install damaged components.

C. Fit joints to produce hairline joints free of burrs and distortion.

D. Rigidly secure nonmovement joints.

E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

F. Seal perimeter and other joints watertight unless otherwise indicated.

G. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

H. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.

I. Install joint filler behind sealant as recommended by sealant manufacturer.

J. Install components plumb and true in alignment with established lines and grades.

K. Install entrance doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware in accordance with entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

L. Install glazing as specified in Section 088000 "Glazing."

3.3 ERECTION TOLERANCES

A. Install aluminum-framed entrance and storefront systems to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
3. Alignment:

    a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
    b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
    c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).

4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.

3.4 FIELD QUALITY CONTROL

A. Tests: Perform the following tests on representative areas of aluminum-framed entrance and storefront systems.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect to be tested in accordance with AAMA 501.2 and to not evidence water penetration.

    a. Perform a minimum of two tests in areas as directed by Architect.
    b. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 35, and 70 percent completion.

B. Aluminum-framed entrance and storefront systems will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 084113

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SECTION 084126 - ALL-GLASS ENTRANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 PRE-INSTALLATION MEETINGS

A. Pre-installation Conference: Refer to Division 01 Section "Project Requirements".

1.3 SUBMITTALS

A. Product Data: For each type of all-glass entrance component specified. Details of construction relative to materials, dimensions of individual components, profiles, and finishes, including:

1. Glass panels.
2. Rail and Patch fittings.
3. Closer and pivots.
4. Door hardware and accessories.

B. Shop Drawings: Show details of fabrication and installation, including the following:

1. Plans, elevations, and sections.
2. Details of fittings.
3. Hardware quantities, locations, and installation requirements.
4. Anchorages and reinforcement.
5. Glazing details.
6. Door hardware locations, mounting heights, and installation requirements.

C. Samples for Verification: For each type of exposed finish indicated, prepared on Samples of size indicated below as required by Architect.

1. Metal Finishes: 6-inch (150-mm) long sections of rail fittings.
2. Glass: 12-inch (300 mm) square, showing exposed-edge finish and tint.

D. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing, fabrication, and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, sidelites, transoms, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

   a. Type, style, function, size, label, hand, and finish of each door hardware item.
   b. Manufacturer of each item.
   c. Fastenings and other pertinent information.
   d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
   e. Explanation of abbreviations, symbols, and codes contained in schedule.
   f. Mounting locations for door hardware.
   g. Door and frame sizes and materials.
   h. Warranty information for each product.

E. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule

F. Maintenance Data: For all-glass systems to include in maintenance manuals.

1.4 PROJECT CONDITIONS

A. Field Measurements: Verify opening dimensions of all-glass entrances by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.5 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty: Submit a written warranty executed by the manufacturer agreeing to repair or replace components of all-glass entrances that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, the following:

   1. Structural failures.
   2. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   3. Failure of operating components to function normally.

C. General Warranty Period: Two years from date of Substantial Completion.

1. Concealed Floor Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design all-glass entrances and storefronts.

B. General Performance: Comply with performance requirements specified, as determined by testing of all-glass entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings
3. Deflection Limits: In accordance with GANA “Fully Tempered Heavy Glass Door and Entrance Systems Design Guide.”

D. Seismic Performance: All-glass entrances and storefronts shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. Coordinate requirements with structural engineer.

E. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

F. Accessibility Standards: Comply with applicable provisions in Accessibility Guidelines for Buildings and Facilities ICC (ANSI) A117.1 and requirements of authorities having jurisdiction.

2.2 MANUFACTURERS

A. Basis-of-Design Products: Subject to compliance with requirements, provide the named product, or the comparable product by one of the alternate specified manufacturers. Comparable products are subject to review and approval through the submittal process specified.

B. Manufacturers (All Glass Doors): Subject to compliance with requirements, provide products by one of the following:

1. Rockwood (All Glass Door components).

2.3 INTERIOR GLASS ENTRY DOORS

A. DOOR MATERIALS

1. Clear Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated surfaces), Type I (transparent), Class 1 (clear) requirements. Provide products of thickness indicated that have been tested for surface and edge compression according to ASTM C 1048 and for impact strength according to CPSC 16 CFR, Part 1201 for Category II materials.

    a. Thickness: 1/2 inch (13 mm)
    b. Exposed Edges: Flat polished.
    c. Butt Edges: Flat polished.
    d. Corner Edges: Mitered.
2. Stainless-Steel Cladding: ASTM A 666, Type 302 or Type 304.

2.4 DOOR COMPONENTS

A. Patch Fittings: Provide manufacturer's standard patch fittings for all-glass entrance configurations required, unless otherwise indicated, and as follows:

1. Material: Bright or satin stainless-steel-cladding.
2. Basis of Design: Rockwood #PFD.

B. Floating Transom Bar: Manufacturer's standard aluminum, floating transom bar clad in metal matching fittings in size recommended by manufacturer for application indicated.

1. Support Fins: Tempered glass matching the transom glass.

C. Sidelite Channels: Provide manufacturer's standard head and sill channels for sidelite and transom-head support matching fitting-metal finish, unless otherwise indicated.

D. Concealed Sidelite Channels: Provide manufacturer's standard recessed head and sill channels for concealed sidelite and transom-head support, unless otherwise indicated.

E. Rails: Manufacturer's standard continuous horizontal fittings and as follows:

1. Rail Locations: As follows:

    a. Door tops and bottoms.
    b. Transom tops. Provide with manufacturer's standard fixed-mounting system.
    c. Sidelite tops. Provide with manufacturer's standard fixed-mounting system.
    d. Sidelite bottoms. Provide with manufacturer's standard fixed-mounting system.

2. Top Rail Height: 4 inch tapered (102 mm).
3. Top Rail Profile: Tapered no less than 60 degrees from horizontal.
4. Bottom Rail Height: 4 inch tapered (102 mm).
5. Bottom Rail Profile: Tapered no less than 60 degrees from horizontal.
6. One piece dry glazed compression system that accommodates 3/8” to 9/16” or 5/8” to 13/16” thick glass.
7. End Caps: One-piece aluminum, beveled.
8. Material: Aluminum.
9. Material: Bright or satin stainless-steel-cladding.
10. Basis of Design: Rockwood #DRT/DRS x Height.

F. Accessory Fittings: Manufacturer's standard accessory fittings matching patch fitting or rail metal and finish for the following:

1. Overhead doorstop.
2. Center-housing lock.
3. Glass-support fins.

G. Anchors and Fastenings: Manufacturer's standard concealed anchors and fastenings.

H. Weather Stripping; Brush type; replaceable without removing all-glass entrance doors from pivots.

2.5 ENTRANCE DOOR HARDWARE

A. General: Heavy-duty entrance door hardware units in sizes, quantities, and types recommended by manufacturer for all-glass entrance systems indicated. For exposed parts, match metal and finish of patch fittings and rail fittings.

B. Refer to section 080671 “Door Hardware Schedule” for specific hardware sets.

C. Cylinders and Keying: Refer to Section 087100 Door Hardware.

D. Door Pulls, Dummy and Mating Pulls: Door pushes and pulls of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
2. Fasteners: Provide manufacturer's designated fastener type as indicated in hardware sets.

3. Manufacturers:

a. Rockwood (GS).
b. Rockwood (RO).

E. Overhead Concealed Closers (Medium Duty): Center hung, BHMA A156.4, Grade 1; units including arms, pivots, cover plates, mounting clips, and accessories required for complete installation. Provide separate closing and latching valves for closing speed, latch speed, backcheck, and optional hold open.

1. Compact cast iron closers capable of being fully concealed in the frame head for center hung applications.
2. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, interior or exterior application, and exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ICC/ANSI A117.1.
3. Closer Accessories: Provide door closer accessories including custom spindles and templates as required for proper installation.
4. Double acting, non-handed with adjustable spring power size 1 through 3.

5. Manufacturers:

a. Rockwood (GS) - OHC 609 Series.

2.6 FABRICATION

A. General: Fabricate all-glass entrance components in sizes, profiles, and configurations indicated on Drawings.

B. Provide holes and cutouts in glass to receive hardware, fittings, and accessory fittings before tempering glass. Do not cut, drill, or make other alterations to glass after tempering.

1. Fully temper glass using horizontal (roller-hearth) process, and fabricate so that when glass is installed, roll-wave distortion is parallel with bottom edge of door or lite.

C. Factory assemble components and factory install hardware and fittings to greatest extent possible.

2.7 FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

2.8 STAINLESS-STEEL FINISHES

A. Remove or blend tool and die marks and stretch lines into finish.

B. Grind and polish surfaces to produce uniform, directional textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

C. Bright, Directional Polish: No. 4 finish.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clear.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 DOOR INSTALLATION

A. General: Comply with all-glass entrance manufacturer's written installation instructions and approved shop drawings.

B. Install all-glass door assemblies after other finishing operations have been completed. Coordinate installation of recesses housings with installation of adjacent finishes.

C. Set units level, plumb, and true to line, with uniform joints.

D. Maintain uniform clearances between adjacent components.

E. Set, seal, and grout floor closer cases as required to suit hardware and substrate indicated.

F. Install butt-joint sealants according to manufacturer's instructions and as specified in Section 079200 "Joint Sealants" to produce weathertight installation.

3.3 ADJUSTING AND CLEANING

A. Adjust all-glass entrance doors and hardware to produce smooth operation and tight fit at contact points and weather stripping.

B. Remove excess sealant and glazing compounds and dirt from surfaces.

3.4 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure all-glass entrances are without damage or deterioration at the time of Substantial Completion.

3.5 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

3.6 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with

corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.

2. The supplier is responsible for handing and sizing all products.

3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

B. Manufacturer's Abbreviations:

1. GS - ASSA ABLOY Glass Solutions
2. RO - Rockwood

Hardware Sets

Set: 6.0

1	Door Bottom Rail/Patch	As Per Architectural Elevations	US32D	GS
1	Door Top Rail/Patch	As Per Architectural Elevations	US32D	GS
1	Bottom Pivot	PV-ENDLOAD	AL	GS
1	Concealed Closer x HO	OHC-609-90HO		GS
1	Door Stop - Post, Floor	RM850	US26D	RO

END OF SECTION 084126

SECTION 085653 – SECURITY WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Provide:

1. Bullet resistant frames.
2. Forced entry security glazing.
3. Ballistic deal tray.
4. Required hardware and related components.

1.2 REFERENCES

A. AAMA:

1. 606 - Integral Color Anodic Finishes
2. 609 - Cleaning and Maintenance of Architectural Aluminum

B. ASTM:

1. F1233 - Security Glazing Materials and Systems

C. UL 752 - Standard for Bullet Resisting Equipment

1.3 SYSTEM DESCRIPTION

A. Design Requirements:

1. Non-thermally broken frame.
2. Minimum 1/8-inch wall thickness required.
3. Aluminum extrusions allow for insertion of ballistic armor consistent with specified threat level.
4. Glass units easily replaceable.

B. Performance Requirements:

1. Ballistic Testing:
   a. Meet or exceed UL 752.
   b. Provide complete protection against penetration of a projectile as described by UL 752.
   c. Components, including framing, shall meet or exceed the requirements of UL 752, Level 3.
      1) Level 3: 0.44 magnum lead semi-wadcutter gas checked.

1.4 SUBMITTALS

A. Refer to Section 01 33 00.

B. Product Data: Submit manufacturer's current Product Data including:

1. Specifications.
2. Construction details and fabrication methods.
3. Profiles and dimensions of individual components.
4. Data on hardware accessories and finishes.
5. Recommendations for maintenance and cleaning.

C. Shop Drawings: Submit Shop Drawings prepared by manufacturer for each window type, showing system fabrication, installation drawings, including:

1. Layout and installation details, including anchors.
2. Elevations of continuous work at 1/4-inch scale and typical window unit elevations at 3/4-inch scale.
3. Full-size section details of typical composite members, including reinforcement.
4. Hardware.
5. Glazing details.
6. Accessories.

D. Samples:

1. Color Samples: Submit manufacturer's standard color samples with Product Data and Shop Drawings.

E. Quality Assurance Submittals - Test Reports: Provide 2 copies of certification by a recognized independent testing laboratory or agency showing that each type, grade, and size of window unit complies with performance requirements indicated.

F. Maintenance Manual: Provide to Owner, maintenance and warranty data in "Maintenance Manual" at Substantial Completion.

1.5 QUALITY ASSURANCE

A. Single Source Responsibility: Provide complete window units made of components furnished by 1 manufacturer as coordinated assemblies.

B. Qualifications:

1. Manufacturer: 10 years experience in the manufacture of windows and 5 years in the manufacture of security windows.
2. Contractor: 3 years experience in the installation of windows.

3. Personnel: For actual installation of aluminum window, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of work.

C. Regulatory Requirements:

1. Comply with pertinent regulations of governmental agencies having jurisdiction, design criteria recommended by regulatory agencies.

2. Substantiate actual compliance by tests conducted on similar window type of size, construction, as directed by appropriate publication guidelines.

3. Testing to be conducted by H.P. White Laboratory or an approved equivalent independent testing laboratory and testing results made available to Architect upon request

D. Field Samples: If requested, furnish sample of each type of window to Architect for review prior to manufacture/installation. Architect will forward approved sample to the Site for installation.

1.6 PROJECT CONDITIONS

A. Existing Conditions: Inspect the Project prior to installation. If conditions do not meet approval, notify Architect. Proceeding without notification implies acceptance of conditions.

B. Field Dimensions: Drawings do not purport to show actual dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

1.7 WARRANTY

A. Manufacturer: Submit a written warranty agreeing to repair or replace window units that fail in materials or workmanship within the specified warranty period.

1. Failures include but are not necessarily limited to:
   a. Deterioration of metals, metal finishes, and other materials beyond normal wear.

2. Warranty Period: 1 year after the date of Substantial Completion.

B. Contractor - Total Window System:

1. Assume full responsibility and warrant for 1 year the satisfactory performance of the complete installation which includes the windows, frame, hardware, glass, glazing, anchorage and setting system, sealing, flashing, etc. as it relates to air, water, and structural adequacy.

2. Deficiencies due to such elements not meeting the specifications shall be corrected by Contractor at his expense during the warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Bullet Resistant Frame:
   1. Standard of Quality: Unless indicated otherwise, design is based on U.S. Bullet Proofing www.usbulletproofing.com.
   2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
      a. C.R. Laurence Co., Inc. www.crlaurence.com
      b. Gaffco Ballistics, Mt. Vernon, NY www.gaffco.com
      c. Manufacturer of comparable products submitted in compliance with Section 01 25 13.

B. Forced Entry Security Glazing:
   1. Standard of Quality: Unless indicated otherwise, design is based on Oldcastle Glass http://www.oldcastle.com.
   2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
      a. Manufacturer of comparable products submitted in compliance with Section 01 25 13.

C. Ballistic Deal Tray:
   1. Standard of Quality: Unless indicated otherwise, design is based on U.S. Bullet Proofing www.usbulletproofing.com.
   2. Other Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
      a. Manufacturer of comparable products submitted in compliance with Section 01 25 13.

2.2 MATERIALS

A. Bullet Resistant Frames:
   1. Type-1 (Fixed):
      a. Aluminum.
      b. Fixed, interior.
      c. Ballistic Rating: UL 752, Level 3.
      d. Product: USAW300
   2. Color: Factory Painted to match aluminum windows.

B. Forced Entry Security Glazing
   1. Clear.
   2. Thickness: 1-1/4-inch.
   3. Ballistic Rating: UL 752, Level 3.
   4. Product: ArmorProtect Plus
      a. Type: SG-BR3

C. Ballistic Deal Tray:

1. Stainless steel.
2. Size: 12-inch x 10-inch x 2-inch
3. Recessed.
4. Ballistic Rating: UL 752, Level 3.
5. Product: USDT100.

D. Aluminum Extrusions: 6063T5 alloy and temper or equal, or with a minimum tensile strength of 22.0 ksi and a yield strength of 16.0 ksi.

E. Fasteners: Zinc coated, concealed.

F. Gasket Material: Composition of Thermoplastic Elastomer and Polyolefin Foam Concentrate, resulting in a 55 to 65 Shore "A" durometer.

2.3 FABRICATION

A. Fabricate in strict accordance with original design, accepted Shop Drawings, manufacturer's standards, and referenced standards.

1. Include a complete system for assembly of components and anchorage of window units.
2. Provide frames with minimum wall thickness of 0.125 inch.
3. Conceal fasteners on unexposed sides of frame.
4. Provide smooth appearance on visible front and back portions of frame.

B. Frame Joints and Connections: Tight, providing hairline joints and true alignment of adjacent members.

C. Construction Sealants:

1. Butt seal sill, heads, jambs and mullions prior to assembly. Seal sash members with a closed cell polyolefin foam gasket prior to assembly.
2. Screw heads and seams, must be caulked/sealed and sill corners back sealed after assembly.

D. Glazing Stops: Provide screw-applied or snap-on glazing stops, coordinated with glass selection and glazing system indicated. Finish glazing stops to match window units.

E. Construction Cleaning: Pressure clean frame and sash members prior to assembly.

2.4 FINISHES

A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.

B. Finish designations prefixed by “AA” conform to the system established by the Aluminum Association for designating aluminum finishes.

C. Finish:

1. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

D. Joint Sealant: Color of exposed sealants shall be selected by the Architect from manufacturer’s standard colors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.

B. Verification of Conditions: Verify that aluminum windows may be fabricated in accordance with original design, pertinent codes, and regulations, and pertinent portions of referenced standards.

C. Discrepancies: Immediately notify Architect. Do not proceed with installation in areas of discrepancy until fully resolved.

3.2 PREPARATION

A. Properly prepare openings to receive windows. Install furring, blocking, or shimming necessary to support windows and panning.

3.3 INSTALLATION

A. Install, glaze and adjust in accordance with approved Shop Drawings and manufacturer’s instructions.

B. Install window units plumb, square, without warp or rack, so that exposed surfaces of perimeter are uniformly proportioned for balanced appearance.

C. Frames shall not be filled with concrete.

D. Securely anchor both inner and outer frames to existing construction.

E. Ensure impact side of bullet resistant glazing faces the threat axis.

F. Structural Covering Trim: Cover structural elements with aluminum trim to match windows.

G. Touch Up: Touch up minor mars or scratches in aluminum coating with touch-up paint provided or recommended by manufacturer of shop finish. Replace units with major defects or damage at no additional cost.

H. Sealant:

1. Provide gun-installed caulking bead at entire perimeter of each unit to complete air and water seal of the opening. Comply with sealant manufacturer's printed installation instructions.

2. Preparation: Clean, prime surfaces as recommended by sealant manufacturer. Install sealant backer rod where required.

3. Application:
   a. Form neat uniform concave finish at angle between panning and jamb construction.
   b. Fill joints solid with sealant to depth equal to joint width.
   c. Use masking tape or other precautionary measures to prevent staining or smearing adjoining surfaces by either primer or sealant.
   d. Remove excess sealant, inadvertent spillage promptly as work progresses, using means recommended by manufacturer.

3.4 CLEANING

A. Site: Do not allow accumulation of scraps, debris arising from work of this section. Maintain premises in neat, orderly condition.

B. System:

1. After installation, windows and glazing shall be inspected and left clean and free of labels and dirt.

2. Protected side of transparency may be polycarbonate and susceptible to scratching. Use soft cloths or sponges and mixture of liquid soap and water.
   a. Acceptable products: Formula 409, Joy, Palmolive Liquid, Top Job, Windex with Ammonia D.
   b. Remove fresh paint splashes, grease and smeared glazing compounds by rubbing lightly with products recommended by manufacturer.
   c. Minimize scratches and minor abrasions with the application of a mild automobile polish.

3. Final cleaning of anodized finish shall be in accordance with AAMA 609.1.

3.5 DEMONSTRATION

A. Maintenance Instructions: Manufacturer's representative to schedule and attend meeting with Owner's representatives to explain:

1. Maintenance and Care Instructions.

2. Warranty Requirements.

3.6 PROTECTION

A. Protect finished installation against damage.

END OF SECTION

SECTION 087100 - DOOR HARDWARE

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 commercial door hardware for the following:

1. Swinging doors.
2. Sliding doors.
3. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical door hardware.
3. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Hollow Metal Doors and Frames”.
2. Division 08 Section “Flush Wood Doors”.
3. Division 08 Section “Aluminum-Framed Entrances and Storefronts”.
4. Division 08 Section “All-Glass Entrances”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.
7. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:

1. ANSI/BHMA Certified Product Standards - A156 Series.
2. UL10C - Positive Pressure Fire Tests of Door Assemblies.

3. ANSI/UL 294 - Access Control System Units.
4. UL 305 - Panic Hardware.
5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
3. Content: Include the following information:

    a. Type, style, function, size, label, hand, and finish of each door hardware item.
    b. Manufacturer of each item.
    c. Fastenings and other pertinent information.
    d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
    e. Explanation of abbreviations, symbols, and codes contained in schedule.
    f. Mounting locations for door hardware.
    g. Door and frame sizes and materials.
    h. Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
b. Complete (risers, point-to-point) access control system block wiring diagrams.
c. Wiring instructions for each electronic component scheduled herein.

2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

E. Informational Submittals:

1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

B. Project Record Documents: Provide record documentation of as-built door hardware sets in digital format (.pdf, .docx, .xlsx, .csv) and as required in Division 01, Project Record Documents.

1.5 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).

C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the

manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

F. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.

G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

I. At completion of installation, provide written documentation that components were applied according to manufacturer's instructions and recommendations and according to approved schedule.

1.6 DELIVERY, STORAGE AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.7 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.

C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.8 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 BUTT HINGES

A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:

   a. Two Hinges: For doors with heights up to 60 inches.
   b. Three Hinges: For doors with heights 61 to 90 inches.
   c. Four Hinges: For doors with heights 91 to 120 inches.
   d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

   a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.
   b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

   a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
   b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following:

   a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for all out-swinging lockable doors.

5. Manufacturers:

   a. Hager Companies (HA) - BB Series, 5-knuckle.
   b. McKinney (MK) - TA/T4A Series, 5-knuckle.
   c. dormakaba BEST (ST) - F/FBB Series, 5-knuckle.

2.2 CONTINUOUS HINGES

A. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 continuous geared hinge. with minimum 0.120-inch thick extruded 6063-T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.

1. Manufacturers:.

a. Hager Companies (HA).
b. Pemko (PE).
c. dormakaba BEST (ST).

B. Pin and Barrel Continuous Hinges: ANSI/BHMA A156.26 Grade 1-600 pin and barrel continuous hinges with minimum 14 gauge Type 304 stainless steel hinge leaves, concealed stainless pin, and twin self-lubricated nylon bearings at each knuckle separation. Factory trim hinges to suit door height and prepare for electrical cut-outs.

1. Manufacturers:

a. Markar Products; ASSA ABLOY Architectural Door Accessories (MR).
b. Pemko (PE).
c. dormakaba BEST (ST).

2.3 POWER TRANSFER DEVICES

A. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:

a. Pemko (PE) - EL-CEPT Series.
b. Securitron (SU) - EL-CEPT Series.
c. dormakaba BEST (ST) EPT-12C Series.

B. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

1. Provide one each of the following tools as part of the base bid contract:

a. McKinney (MK) - Electrical Connecting Kit: QC-R001.
b. McKinney (MK) - Connector Hand Tool: QC-R003.

2. Manufacturers:

a. Hager Companies (HA) - Quick Connect.
b. McKinney (MK) - QC-C Series.
c. dormakaba BEST (ST) - WH Series.

2.4 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: Provide products conforming to ANSI/BHMA A156.3 and A156.16, Grade 1.

1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
2. Furnish dust proof strikes for bottom bolts.
3. Surface bolts to be minimum 8" in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
5. Manufacturers:

    a. Door Controls International (DC).
    b. Rockwood (RO).
    c. Trimco (TC).

B. Coordinators: ANSI/BHMA A156.3 door coordinators consisting of active-leaf, hold-open lever and inactive-leaf release trigger. Model as indicated in hardware sets.

1. Manufacturers:

    a. Door Controls International (DC).
    b. Rockwood (RO).
    c. Trimco (TC).

C. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Pulls, where applicable, shall be provided with a 10" clearance from the finished floor on the push side to accommodate wheelchair accessibility.
5. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets. When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
6. Manufacturers:

    a. Hiawatha, Inc. (HI).
    b. Rockwood (RO).
    c. Trimco (TC).

2.5 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:

1. Threaded mortise cylinders with rings and cams to suit hardware application.
2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
4. Tubular deadlocks and other auxiliary locks.
5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
6. Keyway: Manufacturer’s Standard.

C. Patented Cylinders: ANSI/BHMA A156.5, Grade 1 Certified Products Directory (CPD) listed cylinders employing a utility patented and restricted keyway requiring the use of a patented key. Cylinders are to be protected from unauthorized manufacture and distribution by manufacturer’s United States patents.

1. Patented key systems shall not be established with products that have an expired patent. Expired systems shall only be specified and supplied to support existing systems.
2. Manufacturers:

a. Corbin Russwin (RU) - Access 3 AP.
b. Medeco (MC) - X4.
c. Sargent (SA) - Degree DG1.

D. Keying System: Each type of lock and cylinders to be factory keyed.

1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
3. New System: Key locks to a new key system as directed by the Owner.

E. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Two (2)
2. Master Keys (per Master Key Level/Group): Five (5).
3. Construction Keys (where required): Ten (10).

F. Construction Keying: Provide construction master keyed cylinders.

G. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.

2. Provide transcript list in writing or electronic file as directed by the Owner.

2.6 KEY CONTROL

A. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.

1. Manufacturers:

a. Lund Equipment (LU).
b. MMF Industries (MM).
c. Telkee (TK).

2.7 MORTISE LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): Provide ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed mortise locksets. Listed manufacturers shall meet all functions and features as specified herein.

1. Manufacturers:

a. Corbin Russwin Hardware (RU) - ML2000 Series.
b. Sargent Manufacturing (SA) - 8200 Series.
c. Schlage (SC) - L9000 Series.

2.8 CYLINDRICAL LOCKS AND LATCHING DEVICES

A. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Operational Grade 1 Certified Products Directory (CPD) listed cylindrical locksets. Listed manufacturers shall meet all functions and features as specified herein.

1. Manufacturers:

a. Corbin Russwin Hardware (RU) - CLX3300 Series.
b. Sargent Manufacturing (SA) - 10X Line.
c. Schlage (SC) - ND Series.

2.9 DEADLOCKS AND LATCHES

A. Cylindrical Deadlocks: ANSI/BHMA A156.36 Grade 1 Certified Products Directory (CPD) listed deadlocks to fit standard ANSI 161 preparation. Provide tapered collars to resist vandalism and 1" throw solid steel bolt with hardened steel roller pins. Deadlocks to be products of the same source manufacturer and keyway as other locksets.

1. Manufacturers:

a. Corbin Russwin Hardware (RU) - DL3000 Series.
b. Sargent Manufacturing (SA) - 480 Series.
c. Schlage (SC) - B600 Series.

2.10 HOSPITAL AND BEHAVIORAL HEALTH PRODUCTS

A. Behavioral Health, Mortise: ANSI/BHMA A156.13, Series 1000, Operational and Security Grade 1 Certified Products Directory (CPD) listed mortise type manufactured to Office of Mental Health (OMH) requirements with behavioral health lever and escutcheon trim. Locksets to be manufactured with a corrosion resistant, formed steel case. Levers and escutcheons are manufactured from stainless steel material. Provide optional lead-lining (lock body), Torx® fasteners, and Antimicrobial coating as specified in Hardware Sets.

1. Manufacturers:

a. Corbin Russwin (RU) - ML2000 BHSS Series.
b. Sargent Manufacturing (SA) - 8200 BHW Series.
c. No Substitution.

2.11 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.12 ELECTRIC STRIKES

A. Standard Electric Strikes: Electric strikes conforming to ANSI/BHMA A156.31, Grade 1, for use on non-rated or fire rated openings. Strikes shall be of stainless steel construction tested to a minimum of 1500 pounds of static strength and 70 foot-pounds of dynamic strength with a minimum endurance of 1 million operating cycles. Provide strikes with 12 or 24 VDC capability, fail-secure unless otherwise specified. Where specified provide latchbolt and

latchbolt strike monitoring indicating both the position of the latchbolt and locked condition of the strike.

1. Manufacturers:

    a. HES (HS) - 1500/1600 Series.

B. Surface Mounted Rim Electric Strikes: Surface mounted rim exit device electric strikes conforming to ANSI/BHMA A156.31, Grade 1, and UL Listed for both Burglary Resistance and for use on fire rated door assemblies. Construction includes internally mounted solenoid with two heavy-duty, stainless steel locking mechanisms operating independently to provide tamper resistance. Strikes tested for a minimum of 500,000 operating cycles. Provide strikes with 12 or 24 VDC capability supplied standard as fail-secure unless otherwise specified. Option available for latchbolt and latchbolt strike monitoring indicating both the position of the latchbolt and locked condition of the strike. Strike requires no cutting to the jamb prior to installation.

1. Manufacturers:

    a. HES (HS) - 9400/9500/9600/9700/9800 Series.

C. Provide electric strikes with in-line power controller and surge suppressor by the same manufacturer as the strike with the combined products having a five year warranty.

2.13 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. Exit devices shall have a five-year warranty.
2. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
3. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer’s catalog and template book for specific requirements.
4. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
5. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.

    a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.

b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.

7. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
9. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
10. Rail Sizing: Provide exit device rails factory sized for proper door width application.
11. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed exit devices. Listed manufacturers shall meet all functions and features as specified herein.

1. Electromechanical exit devices shall have the following functions and features:

a. Universal Molex plug-in connectors that have standardized color-coded wiring and are field configurable in fail safe or fail secure and operate from 12vdc to 24vdc regulated.
b. EcoFlex or equivalent technology that reduces energy consumption up to 92% as certified by GreenCircle.
c. Options to be available for request-to-exit or enter signaling, latchbolt and touchbar monitoring.
d. Field configurable electrified trim to fail-safe or fail-secure that operates from 12-24VDC.
e. Five-year limited warranty for electromechanical features.

2. Manufacturers:

a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
b. Sargent Manufacturing (SA) - 80 Series.
c. dormakaba BEST (PR) - Apex 2000 Series.

2.14 SURFACE DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.

4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Large Body Cast Iron): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control.

1. Large body cast iron surface mounted door closers shall have a 30-year warranty.
2. Manufacturers:

a. Corbin Russwin Hardware (RU) - DC8000 Series.
b. Norton Rixson (NO) - 9500 Series.
c. Sargent Manufacturing (SA) - 281 Series.

2.15 OVERHEAD CONCEALED DOOR CLOSERS

A. Door Closers, Overhead Concealed (Heavy Duty): Door Closers, Overhead Concealed (Heavy Duty): ANSI/BHMA 156.4 Grade 1 Certified Products Directory (CPD) listed heavy duty door closers. Listed manufacturers shall meet all functions and features as specified herein.

1. Manufacturers:

a. Norton Rixson (NO) - 7900 Series.
b. Sargent Manufacturing (SA) - 268/269/278 Series.

2.16 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1” LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
3. Where plates are applied to fire rated doors with the top of the plate more than 16” above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer’s catalog and template book for specific requirements for size and applications.
4. Protection Plates: ANSI/BHMA A156.6 protection plates (kick, armor, or mop), fabricated from the following:

a. Stainless Steel: 300 grade, 050-inch thick.

5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
6. Manufacturers:

a. Hiawatha, Inc. (HI).
b. Rockwood (RO).
c. Trimco (TC).

2.17 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Manufacturers:

a. Hiawatha, Inc. (HI).
b. Rockwood (RO).
c. Trimco (TC).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Manufacturers:

a. Norton Rixson (RF).
b. Rockwood (RO).
c. Sargent Manufacturing (SA).

2.18 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NFPA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers:

1. National Guard Products (NG).
2. Pemko (PE).
3. Reese Enterprises, Inc. (RE).

2.19 ELECTRONIC ACCESSORIES

A. Request-to-Exit Motion Sensor: Request-to-Exit Sensors motion detectors specifically designed for detecting exiting through a door from the secure area to a non-secure area. Include built-in timers (up to 60 second adjustable timing), door monitor with sounder alert, internal vertical pointability coverage, 12VDC or 24VDC power and selectable relay trigger with fail safe/fail secure modes.

1. Manufacturers:

a. Alarm Controls (AK) - SREX Series.
b. Securitron (SU) - XMS Series.

B. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.

1. Manufacturers:

a. Securitron (SU) - DPS Series.

2.20 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.21 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Push Plates and Door Pulls: When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.

E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

F. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.
2. The supplier is responsible for handing and sizing all products.
3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

B. Manufacturer’s Abbreviations:

1. GS - ASSA ABLOY Glass Solutions
2. MK - McKinney
3. PE - Pemko
4. MR - Markar
5. SU - Securitron
6. RO - Rockwood
7. SA - SARGENT
8. HS - HES
9. RF - Rixson
10. HD - HID
11. OT - Other

Hardware Sets

Set: 1.0

1	Continuous Hinge x EPT (AL)	CFM SLF-HD1 PT x Dr Ht		PE
1	Electric Power Transfer	EL-CEPT	630	SU
1	Rim Exit (NL, ELR, RX)	DG1 43 55 56 8804 Less Pull	US32D	SA
1	Offset Pull (Grip Zone)	RM3411-72 x 12HD MP	US32	RO
1	Conc Overhead Stop	1-X36	630	RF
1	Closer - Top Jamb	281 O	EN	SA
1	Brush Sweep	18061CNB		PE
1	Threshold - 5" T-Break	252x3AFG		PE
1	E-Lynx Harness (Frame)	QC-C3000P		MK
1	E-Lynx Harness (Door)	QC-C*** (length / type as req'd)		MK
1	Card Reader	By Security Contractor	BLK	HD
1	Wiring Diagram	Elevation & Point to Point		OT
1	Door Position Switch	DPS-M / W-GY (as req'd)		SU

Notes:
-Weatherstripping/Door edge gasketing furnished by Aluminum Door/Frame supplier.
-Furnish all necessary brackets/spacers and plates necessary for a complete and proper installation of hardware items listed.

Door normally closed and locked.
Valid card read retracts latch for entry. Key override available.
Door can be unlocked on a time schedule set in EAC system, to act as push/pull.
Door position switch indicates door status.
REX switch in push bar signals authorized egress.
Free egress at all times.

Set: 2.0

1	Continuous Hinge (WD/HM)	CFM HD1-M x Dr Ht		PE
1	Rim Exit (exit only)	43 8810 EO	US32D	SA
1	Closer x HD Stop	281 CPS	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Rain Guard	346C (frame width)		PE
1	Gasketing	2891AS (head/jambs)		PE
1	Brush Sweep	18061CNB		PE
1	Threshold - 6" T-Break	253x3AFG		PE

Notes: Install gasketing at head before installing closer(s).
Install gasketing at jambs before installing rim exit strike.

Set: 3.0

3	Hinge (heavy weight)	T4A3386 (NRP)	US32D	MK
1	Storeroom Lock	DG1 10XG04 LL	US26D	SA
1	Electric Strike	1500C	630	HS
1	Closer x Stop	281 PS	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO

1	Gasketing	2891AS (head)		PE
2	Gasketing	290AS (jambs)		PE
1	Rain Guard	346C (frame width)		PE
1	Brush Sweep	18061CNB		PE
1	Threshold - 6" T-Break	253x3AFG		PE
1	E-Lynx Harness (Frame)	QC-C3000P		MK
1	Card Reader	By Security Contractor	BLK	HD
1	Door Position Switch	DPS-M / W-GY (as req'd)		SU
1	Motion Sensor REX	XMS		SU

Notes: Include keypad (by Security Vendor) where indicated on drawings.
Install gasketing at head before installing closer.

Door normally closed and locked.
Valid card read unlocks electric strike for entry.
Key override available.
DPS indicates door status.
Motion sensor REX signals valid egress.
Free egress at all times.

Set: 4.0

1	Continuous Hinge (WD/HM)	CFM HD1-M x Dr Ht		PE
1	Entry/Office Lock	DG1 10XG05 LL	US26D	SA
1	Surf Overhead Hold Open	10-X26	630	RF
1	Gasketing	2891AS (head)		PE
2	Gasketing	290AS (jambs)		PE
1	Rain Guard	346C (frame width)		PE
1	Brush Sweep	18061CNB		PE
1	Threshold - Panic	2009APK		PE

Set: 5.0

2	Hinge	TA2314 (NRP)	US32D	MK
1	Utility/Institutional Lock	DG1 10XG17 LL	US26D	SA
1	Closer x Stop/HO	281 PSH	EN	SA
1	Gasketing	2891AS (head)		PE
2	Gasketing	290AS (jambs)		PE
1	Rain Guard	346C (frame width)		PE
1	Brush Sweep	18061CNB		PE
1	Threshold - 6" T-Break	253x3AFG		PE

Notes:
Door locked on both sides, so you need a key to get onto the roof.
Door can be held open by door closer while working on roof.
Door does not allow free egress.

Set: 6.0

1	Door Bottom Rail/Patch	As Per Architectural Elevations	US32D	GS
1	Door Top Rail/Patch	As Per Architectural Elevations	US32D	GS
1	Bottom Pivot	PV-ENDLOAD	AL	GS
1	Concealed Closer x HO	OHC-609-90HO		GS
1	Door Stop - Post, Floor	RM850	US26D	RO

Set: 7.0

3	Hinge (heavy weight)	T4A3786 (NRP)	US26D	MK
1	Rim Exit (NL)	DG1 43 8804 Less Pull	US32D	SA
1	Electric Strike	9600	630	HS
1	SMART Pac Bridge Rectifier	2005M3		HS
1	Offset Pull	RM201	US32D	RO
1	Closer x Stop/HO	281 PSH	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Wall Stop	402 / 405 (as req'd)	US26D	RO
1	E-Lynx Harness (Frame)	QC-C3000P		MK
1	Card Reader	By Security Contractor	BLK	HD

Notes: Include keypad (by Security Vendor) where indicated on drawings.
Omit hold open at Door 106.

Door normally closed and locked.
Valid card read unlocks electric strike for entry.
Key override available.
Free egress at all times.

Set: 8.0

3	Hinge (heavy weight)	T4A3786 (NRP)	US26D	MK
1	Rim Exit (NL)	DG1 43 8804 Less Pull	US32D	SA
1	Electric Strike	9600	630	HS
1	SMART Pac Bridge Rectifier	2005M3		HS
1	Offset Pull	RM201	US32D	RO
1	Closer x Stop	281 PS	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Perimeter Gasketing	S88BL (head & jambs)		PE
1	E-Lynx Harness (Frame)	QC-C3000P		MK
1	Card Reader	By Security Contractor	BLK	HD

Notes: Include keypad (by Security Vendor) where indicated on drawings.

Door normally closed and locked.
Valid card read unlocks electric strike for entry.
Key override available.
Free egress at all times.

Set: 9.0

3	Hinge	TA2714 (NRP)	US26D	MK
1	Rim Exit (classroom lvr)	43 8813 ETL	US32D	SA
1	Closer x Stop/HO	281 PSH	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO

Set: 10.0

1	Continuous Hinge x Hosp Tip	FM300 HT x Dr Ht	630	MR
1	Magnetic Lock - Delayed Egress	DEM680E	630	SU
1	Passage Latch - Ligature Resistant	8215 BHW	US32D	SA
1	Mortise Cylinder	Size / Cam As Required (DG1)	US32D	SA
1	Closer x HD Stop	281 CPS	EN	SA
1	Kick Plate	K1050 10" 4BE CSK x TORX	US32D	RO
1	E-Lynx Harness (Frame)	QC-C3000P		MK
2	Card Reader	By Security Contractor	BLK	HD

Notes: Include keypad (by Security Vendor) where indicated on drawings.

Door normally closed and locked by mag lock.
Mag lock senses movement of the door. If someone tries to open the door without first presenting a valid card at either card reader, it begins the irreversible delay sequence: local alarm sounds, door remains locked for 15 seconds. After 15 seconds, magnet releases for access/egress.
Immediate egress on fire alarm or loss of power to the mag lock.
Valid card read on either side of the door by-passes the delayed egress for entry to or egress from Arrestee room.

Set: 11.0

3	Hinge (heavy weight)	T4A3786 (NRP)	US26D	MK
1	Storeroom Lock	DG1 10XG04 LL	US26D	SA
1	Electric Strike	1500C	630	HS
1	Wall Stop	402 / 405 (as req'd)	US26D	RO
1	E-Lynx Harness (Frame)	QC-C3000P		MK
1	Card Reader	By Security Contractor	BLK	HD

Notes: Include keypad (by Security Vendor) where indicated on drawings.

Door normally closed and locked.
Valid card read unlocks electric strike for entry.
Key override available.
Free egress at all times.

Set: 12.0

3	Hinge (heavy weight)	T4A3786 (NRP)	US26D	MK
1	Storeroom Lock	DG1 10XG04 LL	US26D	SA
1	Electric Strike	1500C	630	HS
1	Conc Overhead Stop	2-X36	630	RF
1	E-Lynx Harness (Frame)	QC-C3000P		MK

1	Card Reader	By Security Contractor	BLK	HD

Notes: Include keypad (by Security Vendor) where indicated on drawings.

Door normally closed and locked.
Valid card read unlocks electric strike for entry.
Key override available.
Free egress at all times.

Set: 13.0

3	Hinge (heavy weight)	T4A3786 (NRP)	US26D	MK
1	Storeroom Lock	DG1 10XG04 LL	US26D	SA
1	Electric Strike	1500C	630	HS
1	Closer - Reg / PA Arm (as req'd)	281 UO	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Wall Stop	402 / 405 (as req'd)	US26D	RO
1	E-Lynx Harness (Frame)	QC-C3000P		MK
1	Card Reader	By Security Contractor	BLK	HD

Notes: Include keypad (by Security Vendor) where indicated on drawings.

Door normally closed and locked.
Valid card read unlocks electric strike for entry.
Key override available.
Free egress at all times.

Set: 14.0

3	Hinge (heavy weight)	T4A3786 (NRP)	US26D	MK
1	Storeroom Lock	DG1 10XG04 LL	US26D	SA
1	Electric Strike	1500C	630	HS
1	Closer x Stop	281 PS	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	E-Lynx Harness (Frame)	QC-C3000P		MK
1	Card Reader	By Security Contractor	BLK	HD

Notes: Include keypad (by Security Vendor) where indicated on drawings.

Door normally closed and locked.
Valid card read unlocks electric strike for entry.
Key override available.
Free egress at all times.

Set: 15.0

1	Continuous Hinge x Hosp Tip x EPT	FM300 HT CTP x Dr Ht	630	MR
1	Electric Power Transfer	EL-CEPT	630	SU
1	Fail Secure Lock - Ligature Resistant	DG1 8271 BHW	US32D	SA

1	Concealed Closer	269 OB	EN	SA
1	Kick Plate	K1050 10" 4BE CSK x TORX	US32D	RO
1	E-Lynx Harness (Frame)	QC-C3000P		MK
1	E-Lynx Harness (Door)	QC-C*** (length / type as req'd)		MK
2	Card Reader	By Security Contractor	BLK	HD
1	Alarm	PZ1		SU
1	Door Position Switch	DPS-M / W-GY (as req'd)		SU

Notes: Include keypad (by Security Vendor) where indicated on drawings.

Door normally closed and locked from Arrestee side.
Valid card read on Arrestee side unlocks outside lever for entry.
Valid card read inside 146 Hard by-passes alarm.
If door opens without valid card read, signal from door position switch sounds local alarm (PZ1) indicating someone is leaving the room without authorization.
Free egress at all times.

Set: 16.0

3	Hinge (heavy weight)	T4A3786 (NRP)	US26D	MK
1	Storeroom Lock	DG1 10XG04 LL	US26D	SA
1	Electric Strike	1500C	630	HS
1	Surf Overhead Stop	10-X36	630	RF
1	Closer - Reg / PA Arm (as req'd)	281 UO	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	E-Lynx Harness (Frame)	QC-C3000P		MK
1	Card Reader	By Security Contractor	BLK	HD

Notes: Include keypad (by Security Vendor) where indicated on drawings.

Door normally closed and locked.
Valid card read unlocks electric strike for entry.
Key override available.
Free egress at all times.

Set: 17.0

3	Hinge (heavy weight)	T4A3786 (NRP)	US26D	MK
1	Utility/Institutional Lock	DG1 10XG17 LL	US26D	SA
1	Electric Strike	1500C	630	HS
1	SMART Pac Bridge Rectifier	2005M3		HS
1	Closer - Reg / PA Arm (as req'd)	281 UO	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Wall Stop	402 / 405 (as req'd)	US26D	RO
1	E-Lynx Harness (Frame)	QC-C3000P		MK
2	Card Reader	By Security Contractor	BLK	HD

Notes: Include keypad (by Security Vendor) where indicated on drawings.

Door normally closed and locked on both sides.
Valid card read on either side unlocks electric strike for access.
Key override available.
Door does not allow free egress.

Set: 18.0

6	Hinge	TA2714 (NRP)	US26D	MK
2	Manual Flush Bolt	555/557 (as req'd)	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Storeroom Lock	DG1 10XG04 LL	US26D	SA
2	Surf Overhead Hold Open	10-X26	630	RF

Set: 19.0

6	Hinge	TA2714 (NRP)	US26D	MK
1	C/L Flush Bolt Set	2845/2945 (as req'd)	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Storeroom Lock	DG1 10XG04 LL	US26D	SA
1	Coordinator	2600 Series x FB x Wear Plates	Black	RO
2	Mounting Bracket	2601AB/C	Black	RO
2	Closer x Stop/HO	281 PSH	EN	SA
1	Astragal Edge Seal	S772BL x Dr Ht		PE
1	Perimeter Gasketing	S88BL (head & jambs)		PE

Set: 20.0

3	Hinge	TA2714 (NRP)	US26D	MK
1	Storeroom Lock	DG1 10XG04 LL	US26D	SA
1	Surf Overhead Stop	10-X36	630	RF

Set: 21.0

3	Hinge	TA2714 (NRP)	US26D	MK
1	Entry/Office Lock	DG1 10XG05 LL	US26D	SA
1	Wall Stop	402 / 405 (as req'd)	US26D	RO

Set: 22.0

3	Hinge	TA2714 (NRP)	US26D	MK
1	Entry/Office Lock	DG1 10XG05 LL	US26D	SA
1	Surf Overhead Stop	10-X36	630	RF

Set: 23.0

3	Hinge	TA2714 (NRP)	US26D	MK
1	Classroom Lock	DG1 10XG37 LL	US26D	SA
1	Wall Stop	402 / 405 (as req'd)	US26D	RO

Set: 24.0

3	Hinge	TA2314 (NRP)	US32D	MK
1	Classroom Lock	DG1 10XG37 LL	US26D	SA
1	Surf Overhead Hold Open	10-X26	630	RF
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO

Set: 25.0

3	Hinge	TA2314 (NRP)	US32D	MK
1	Classroom Lock	DG1 10XG37 LL	US26D	SA
1	Surf Overhead Stop	10-X36	630	RF
1	Closer - Regular Arm	281 O	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Mop Plate	K1050 4" 4BE CSK	US32D	RO

Set: 26.0

3	Hinge	TA2314 (NRP)	US32D	MK
1	Privacy Set (OCC/VAC)	V21 8265 LNL	US26D	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Mop Plate	K1050 4" 4BE CSK	US32D	RO
1	Wall Stop	402 / 405 (as req'd)	US26D	RO

Notes:
Match lever height of cylindrical locks (where cylindrical is used).

Set: 27.0

3	Hinge	TA2314 (NRP)	US32D	MK
1	Privacy Set (OCC/VAC)	V21 8265 LNL	US26D	SA
1	Surf Overhead Hold Open	10-X26	630	RF
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Mop Plate	K1050 4" 4BE CSK	US32D	RO

Notes:
Match lever height of cylindrical locks (where cylindrical is used).

Set: 28.0

3	Hinge	TA2314 (NRP)	US32D	MK
1	Privacy Set (OCC/VAC)	V21 8265 LNL	US26D	SA
1	Closer - Reg / PA Arm (as req'd)	281 UO	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Mop Plate	K1050 4" 4BE CSK	US32D	RO
1	Door Stop & Keeper	477	US26D	RO

Notes:
Match lever height of cylindrical locks (where cylindrical is used).

Set: 29.0

3	Hinge	TA2714 (NRP)	US26D	MK
1	Passage Latch	10XU15 LL	US26D	SA
1	Wall Stop	402 / 405 (as req'd)	US26D	RO

Set: 30.0

3	Hinge	TA2714 (NRP)	US26D	MK
1	Pull x Plate	126x70C	US32D	RO
1	Push Plate	70E	US32D	RO
1	Closer - Reg / PA Arm (as req'd)	281 UO	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Wall Stop	402 / 405 (as req'd)	US26D	RO

Set: 31.0

3	Hinge	TA2714 (NRP)	US26D	MK
1	Pull x Plate	126x70C	US32D	RO
1	Push Plate	70E	US32D	RO
1	Closer - Reg / PA Arm (as req'd)	281 UO	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Door Stop & Holder	494S	US26D	RO

Set: 32.0

3	Hinge	TA2714 (NRP)	US26D	MK
1	Pull x Plate	126x70C	US32D	RO
1	Push Plate	70E	US32D	RO
1	Surf Overhead Stop	10-X36	630	RF
1	Closer - Regular Arm	281 O	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO

Set: 33.0

3	Hinge	TA2714 (NRP)	US26D	MK
1	Deadbolt	DG1 485	US26D	SA
1	Pull x Plate	126x70C	US32D	RO
1	Push Plate	70E	US32D	RO
1	Closer - Regular Arm	281 O	EN	SA
1	Kick Plate	K1050 10" 4BE CSK	US32D	RO
1	Door Stop & Holder	494S	US26D	RO

Set: 34.0

1	All Hardware	By Door Manufacturer		OT

END OF SECTION 087100

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SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass products.
2. Insulating glass.
3. Miscellaneous glazing materials.

1.2 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C1036.

C. IBC: International Building Code.

D. Interspace: Space between lites of an insulating-glass unit.

1.3 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples: For each type of the following products; 12 inches (300 mm) square.

1. Tinted glass.
2. Coated glass.
3. Insulating glass.
4. Spandrel glass.

C. Glazing Accessory Samples: For sealants and colored spacers, in 12-inch (300-mm) lengths.

D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

E. Delegated Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For glass.

C. Product Test Reports: For fabricated glass and glazing sealants, for tests performed by a qualified testing agency.

1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

D. Preconstruction adhesion and compatibility test report.

E. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

A. Fabricated-Glass Manufacturer Qualifications: A qualified manufacturer of fabricated glass units who is approved and certified by primary glass manufacturer.

B. Installer Qualifications: A qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors.

C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials in accordance with manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F (4.4 deg C).

1.9 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Glass: Obtain tinted and coated glass from single source from single manufacturer.

B. Source Limitations for Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.

C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined in accordance with the IBC and ASTM E1300:

D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
3. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on most current non-beta version of LBL's WINDOW computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
4. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on most current non-beta version of LBL's WINDOW computer program.
5. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. NGA Publications: "Glazing Manual."
2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the IGCC.

D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than thickness indicated.

1. Minimum Glass Thickness for Exterior Lites: 6 mm.
2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.

E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance

Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.

B. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

C. Low-E-Coated Vision Glass: ASTM C1376.

D. Ceramic-Coated Spandrel Glass: ASTM C1048, Type I, Condition B, Quality-Q3.

2.5 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified in accordance with ASTM E2190.

1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
2. Perimeter Spacer: Manufacturer's standard spacer material and construction.
3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.6 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks:

1. EPDM with Shore A durometer hardness of 85, plus or minus 5.
2. Type recommended in writing by sealant or glass manufacturer.

D. Spacers:

1. Neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
2. Type recommended in writing by sealant or glass manufacturer.

E. Edge Blocks:

1. EPDM with Shore A durometer hardness per manufacturer's written instructions.

2. Type recommended in writing by sealant or glass manufacturer.

2.7 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch- (3-mm-) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended in writing by gasket manufacturer.

3.4 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.5 CLEANING AND PROTECTION

A. Immediately after installation, remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.6 MONOLITHIC GLASS SCHEDULE

A. Clear Glass Type: Glazing-1

1. Minimum Thickness: 6 mm.
2. Fully tempered clear float glass
3. Safety glazing required.

3.7 INSULATING GLASS SCHEDULE

A. Low-E-Coated, Clear Insulating Glass Type: Glazing-2

1. Overall Unit Thickness: 1 inch (25 mm).
2. Minimum Thickness of Each Glass Lite: 6 mm.
3. Outdoor Lite: Low-E clear float glass.
4. Interspace Content: Air.
5. Indoor Lite: Clear float glass.
6. Winter Nighttime U-Factor: 0.29 maximum.
7. Summer Daytime U-Factor: 0.27 maximum.
8. Visible Light Transmittance: 25 percent minimum.
9. SGHC: 0.18 maximum.
10. Safety glazing required.

B. Low-E-Coated, Tinted Insulating Glass Type: Glazing-3

1. Overall Unit Thickness: 1 inch (25 mm).
2. Minimum Thickness of Each Glass Lite: 6 mm.
3. Outdoor Lite: Tinted Low-E #2 float glass.
4. Interspace Content: Air.
5. Indoor Lite: Clear float glass.
6. Winter Nighttime U-Factor: 0.28 maximum.
7. Summer Daytime U-Factor: 0.26 maximum.
8. Visible Light Transmittance: 38 percent minimum.
9. SGHC: 0.20 maximum.
10. Safety glazing required.

C. Low-E-Coated, Tinted Insulating Glass Type: Glazing-4

1. Overall Unit Thickness: 1 inch (25 mm).
2. Minimum Thickness of Each Glass Lite: 6 mm.
3. Outdoor Lite: Tinted Low-E #2 float glass.
4. Interspace Content: Air.
5. Indoor Lite: Clear float glass.
6. Winter Nighttime U-Factor: 0.28 maximum.
7. Summer Daytime U-Factor: 0.26 maximum.
8. Visible Light Transmittance: 38 percent minimum.
9. SGHC: 0.20 maximum.
10. Safety glazing required.
11. Glazing film: 3M Scotchshield S140

D. Ceramic-Coated, Low-E, Tinted Insulating Spandrel Glass Type: Glazing-5

1. Coating Color: As selected by Architect from manufacturer's full range.
2. Overall Unit Thickness: 1 inch (25 mm).
3. Minimum Thickness of Each Glass Lite: 6 mm.
4. Outdoor Lite: Tinted Low-E #2 float glass.
5. Interspace Content: Air.
6. Indoor Lite: Clear float glass.
7. Opaque Coating Location: Fourth surface.
8. Winter Nighttime U-Factor: 0.28 maximum.
9. Summer Daytime U-Factor: 0.26 maximum.

END OF SECTION 088000

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Framing systems.
2. Suspension systems.
3. Grid suspension systems.

B. Related Requirements:

1. Section 054000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; and roof rafters and ceiling joists.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Framing systems.
2. Suspension systems.
3. Grid suspension systems.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of code-compliance certification for studs and tracks.

B. Evaluation Reports: For firestop tracks, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.4 QUALITY ASSURANCE

A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Steel Framing Industry Association.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Notify manufacturer of damaged materials received prior to installation.

B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

C. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, in accordance with ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.

C. Design framing systems in accordance with AISI S220, "North American Specification for the Design of Cold-Formed Steel Framing - Nonstructural Members," unless otherwise indicated.

D. Design Loads: As indicated on architectural Drawings or 5 lbf/sq. ft. (239 Pa) minimum as required by the IBC.

2.2 FRAMING SYSTEMS

A. Framing Members, General: Comply with AISI S220 and ASTM C645, Section 10 for conditions indicated.

1. Steel Sheet Components: Comply with AISI S220 and ASTM C645, Section 10 requirements for metal unless otherwise indicated
2. Protective Coating: Comply with AISI S220; ASTM A653/A653M, G40 (Z120); or coating with equivalent corrosion resistance. Galvannealed products are unacceptable.

    a. Coating demonstrates equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction.

B. Studs and Track: AISI S220 and ASTM C645, Section 10.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. ClarkDietrich.
    b. MRI Steel Framing, LLC.

2. Minimum Base-Steel Thickness: 0.0296 inch (0.752 mm).
3. Depth: As indicated on Drawings.

C. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Single Long-Leg Track System: Top track with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
2. Double-Track System: Top outer tracks, inside track with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction-fit over inner track.
3. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

    a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

        1) ClarkDietrich.
        2) MRI Steel Framing, LLC.

D. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. ClarkDietrich.

E. Cold-Rolled Channel Bridging: Steel, 0.0538-inch (1.367-mm) minimum base-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. ClarkDietrich.
    b. MRI Steel Framing, LLC.

2. Depth: As indicated on Drawings.
3. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.

F. Hat-Shaped, Rigid Furring Channels:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. ClarkDietrich.
    b. MRI Steel Framing, LLC.

2. Minimum Base-Steel Thickness: 0.0296 inch (0.752 mm).
3. Depth: As indicated on Drawings.

G. Resilient Furring Channels: 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound transmission.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. ClarkDietrich.
b. MRI Steel Framing, LLC.

2. Configuration: Asymmetrical.

H. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: As indicated on Drawings.
2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch (0.8 mm).
3. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

I. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (32 mm), wall attachment flange of 3/4 inch (19 mm), minimum uncoated-steel thickness of 0.0179 inch (0.455 mm), and depth required to fit insulation thickness indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. ClarkDietrich.
b. MRI Steel Framing, LLC.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

B. Hanger Attachments to Concrete:

1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, AC193, AC58, or AC308 as appropriate for the substrate.

a. Uses: Securing hangers to structure.
b. Type: Torque-controlled, expansion anchor or adhesive anchor.
c. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.

d. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless steel bolts, ASTM F593 (ASTM F738M), and nuts, ASTM F594 (ASTM F836M).

C. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.

D. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch (1.367 mm) and minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: As indicated on Drawings.

E. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.0538-inch (1.367-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
2. Steel Studs and Tracks:

a. Minimum Base-Steel Thickness: 0.0329 inch (0.836 mm).
b. Depth: As indicated on Drawings.

3. Hat-Shaped, Rigid Furring Channels: 7/8 inch (22 mm) deep.

a. Minimum Base-Steel Thickness: 0.0329 inch (0.836 mm).

4. Resilient Furring Channels: 1/2-inch- (13-mm-) deep members designed to reduce sound transmission.

a. Configuration: Asymmetrical or hat shaped.

2.4 GRID SUSPENSION SYSTEMS

A. Grid Suspension Systems for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Armstrong World Industries.
b. CertainTeed; SAINT-GOBAIN.
c. USG Corporation.

2.5 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C754.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLATION OF FRAMING SYSTEMS

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Single-Layer Application: 16 inches (406 mm) o.c. unless otherwise indicated.
2. Multilayer Application: 16 inches (406 mm) o.c. unless otherwise indicated.
3. Tile Backing Panels: 16 inches (406 mm) o.c. unless otherwise indicated.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.

    a. Install two studs at each jamb unless otherwise indicated.
    b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
    c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

    a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

E. Direct Furring:

1. Screw to wood framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.5 INSTALLATION OF SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Hangers: 48 inches (1219 mm) o.c.
2. Carrying Channels (Main Runners): 48 inches (1219 mm) o.c.

3. Furring Channels (Furring Members): 16 inches (406 mm) o.c.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not attach hangers to steel roof deck.
6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

3.6 INSTALLATION OF GRID SUSPENSION SYSTEMS

A. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

3.7 FIELD QUALITY CONTROL

A. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Tile backing panels.

B. Related Requirements:

1. Section 061600 "Sheathing" for gypsum sheathing for exterior walls.
2. Section 079219 "Acoustical Joint Sealants" for acoustical joint sealants installed in gypsum board assemblies.
3. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.
4. Section 093013 "Ceramic Tiling" for cementitious backer units installed as substrates for ceramic tile.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Gypsum board, Type X.
2. Gypsum ceiling board.
3. Mold-resistant gypsum board.
4. Cementitious backer units.
5. Interior trim.
6. Joint treatment materials.
7. Laminating adhesive.
8. Sound-attenuation blankets.
9. Acoustical sealant.

B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.

C. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.

1.3 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.4 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of gypsum panel and joint finishing material from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated in accordance with ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated in accordance with ASTM E90 and classified in accordance with ASTM E413 by an independent testing agency.

2.3 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.4 INTERIOR GYPSUM BOARD

A. Gypsum Board, Type X: ASTM C1396/C1396M.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. CertainTeed; SAINT-GOBAIN.
   b. Georgia-Pacific Gypsum LLC.
   c. Gold Bond Building Products, LLC provided by National Gypsum Company.
   d. USG Corporation.

2. Thickness: 5/8 inch (15.9 mm).
3. Long Edges: Tapered.

B. Gypsum Ceiling Board: ASTM C1396/C1396M.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. CertainTeed; SAINT-GOBAIN.
   b. Georgia-Pacific Gypsum LLC.
   c. Gold Bond Building Products, LLC provided by National Gypsum Company.
   d. USG Corporation.

2. Thickness: 1/2 inch (12.7 mm).
3. Long Edges: Tapered.

C. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. CertainTeed; SAINT-GOBAIN.
   b. Georgia-Pacific Gypsum LLC.
   c. Gold Bond Building Products, LLC provided by National Gypsum Company.
   d. USG Corporation.

2. Core: 5/8 inch (15.9 mm), Type X.
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

2.5 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. USG Corporation.

2. Thickness: 5/8 inch (15.9 mm).
3. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

2.6 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
2. Shapes:

a. Cornerbead.
b. L-Bead: L-shaped; exposed long flange receives joint compound.
c. Expansion (control) joint.

2.7 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.

a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.
5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.

D. Joint Compound for Tile Backing Panels:

1. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.8 AUXILIARY MATERIALS

A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

E. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

F. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

A. Comply with ASTM C840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Type X: Vertical surfaces unless otherwise indicated.
2. Ceiling Type: Ceiling surfaces.
3. Mold-Resistant Type: To be used in all Toilet Rooms and Janitor Room locations.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.4 INSTALLATION OF TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.

3.5 INSTALLATION OF TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints in accordance with ASTM C840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners unless otherwise indicated.
2. L-Bead: Use where indicated on Drawings.

3.6 FINISHING OF GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and in accordance with ASTM C840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.

2. Level 5: All exposed locations.

a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.7 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Tile.
2. Thresholds.
3. Waterproof membranes.
4. Crack isolation membranes.
5. Setting material.
6. Grout materials.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for sealing of movement joints in tile surfaces.
2. Section 092900 "Gypsum Board" for tile backing panels.

1.2 DEFINITIONS

A. General: Definitions in ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. Face Size: Actual tile size, excluding spacer lugs.

C. Large Format Tile: Tile with at least one edge 15 inches (381 mm) or longer.

D. Module Size: Actual tile size plus joint width indicated.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show locations, plans, and elevations, of each type of tile and tile pattern. Show widths, details, and locations of movement joints in tile substrates and finished tile surfaces.

C. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required.
2. Full-size units of each type of trim and accessory for each color and finish required.
3. Metal flooring transitions 6-inch (152-mm) lengths.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

C. Product Certificates: For each type of product, including product use classification.

D. Product Test Reports:

1. Tile-setting and -grouting products.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials, from the same production run, to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.6 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup of floor tile installation.
2. Build mockup of wall tile installation.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in "Referenced Standards" Article in the Evaluations and manufacturer's written instructions.

1.9 WARRANTY

A. System Warranty: Manufacturer's non-prorated comprehensive warranty that agrees to repair and replace defective installation areas, material, and labor that fail under normal usage within specified warranty period.

1. Warranty Period: Five years from date of Product Purchase.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Tile: Obtain tile of each type and color or finish from single source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Accessory Products: Obtain each of the following products specified in this Section from a single manufacturer:

1. Stone thresholds.
2. Backer units.

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard Grade requirements unless otherwise indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

2.3 TILE

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings.

2.4 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch (1.5 mm) above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch (12.7 mm) or less above adjacent floor surface.

B. Solid Surface: Homogeneous-filled plastic resin complying with ISFA-02-01.

1. Description:

a. Type: Provide Standard type.
b. Colors and Patterns: As selected by Architect from manufacturer's full range.

2.5 WATERPROOF MEMBRANES

A. General: Manufacturer's standard product that complies with ANSI A118.10 and ANSI A118.12 and is recommended by manufacturer for application indicated. Include reinforcement and accessories recommended by manufacturer.

2.6 CRACK ISOLATION MEMBRANES

A. General: Manufacturer's standard product that complies with ANSI A118.12 for high performance and is recommended by manufacturer for application indicated. Include reinforcement and accessories recommended by manufacturer.

2.7 SETTING MATERIALS

A. Standard Dry-Set Mortar (Thinset): ANSI A118.1.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Bostik; Arkema.
b. H.B. Fuller Construction Products Inc. / TEC.
c. Laticrete International, Inc.
d. MAPEI Corporation.

2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to other requirements in ANSI A118.1.

B. Modified Dry-Set Mortar (Thinset): ANSI A118.4.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Bostik; Arkema.
b. H.B. Fuller Construction Products Inc. / TEC.
c. Laticrete International, Inc.
d. MAPEI Corporation.

2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
3. Provide prepackaged, dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive at Project site.
4. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to other requirements in ANSI A118.4.

2.8 GROUT MATERIALS

A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.

B. Standard Cement Grout: ANSI A118.6.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Bostik; Arkema.
b. Custom Building Products.
c. Laticrete International, Inc.
d. MAPEI Corporation.
e. Sika Corporation.

2.9 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting and adhesive materials for installations indicated.

B. Metal Edge Trim: Profile designed for wall terminations and edge protection.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Schluter Systems L.P.

C. Temporary Protective Coating: Formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products and easily removable after grouting is completed without damaging grout or tile.

D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

E. Grout Sealer: Grout manufacturer's standard product for sealing grout joints that does not change color or appearance of grout.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

    a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.

3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove coatings, including curing compounds or other coatings, that are incompatible with tile-setting materials.

B. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

C. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1 and is sloped 1/4 inch per foot (1:50) toward drains.

D. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

E. Substrate Flatness:

1. For tile shorter than 15 inches (381 mm), confirm that structure or substrate is limited to variation of 1/4 inch in 10 ft. (6.4 mm in 3 m) from the required plane, and no more than 1/16 inch in 12 inches (1.5 mm in 300 mm) when measured from tile surface high points.
2. For large format tile, tile with at least one edge 15 inches (381 mm) or longer, confirm that structure or substrate is limited to 1/8 inch in 10 ft. (3 mm in 3 m) from the required plane, and no more than 1/16 inch in 24 inches (1.5 mm in 609 mm) when measured from tile surface high points.

3.3 INSTALLATION OF CERAMIC TILE SYSTEM

A. Install tile backing panels and treat joints in accordance with ANSI A108.11 and manufacturer's written instructions for type of application indicated.

B. Install waterproof membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.

1. Allow waterproof membrane to cure and verify by testing that it is watertight before installing tile or setting materials over it.

C. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

1. Allow crack isolation membrane to cure before installing tile or setting materials over it.

D. Mix mortars and grouts to comply with "Referenced Standards" Article in the Evaluations and mortar and grout manufacturers' written instructions.

1. Add materials, water, and additives in accurate proportions.
2. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

E. Install tile in accordance with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of ANSI A108 series that are referenced in TCNA installation methods and specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:

    a. Tile floors in wet areas.
    b. Tile floors consisting of tiles 8 by 8 inches (200 by 200 mm) or larger.
    c. Tile floors consisting of rib-backed tiles.

2. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
3. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
4. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
5. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.
6. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

    a. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets, so joints between sheets are not apparent in finished Work.
    b. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
    c. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

7. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

F. Movement Joints: Provide movement joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated on Drawings. Form joints during installation of setting materials, mortar beds, and tile. Keep joints free of dirt, debris, and setting materials prior to filling with sealants. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

G. Thresholds: Install stone and solid surface thresholds in same type of setting bed as adjacent floor unless otherwise indicated.

1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in mortar (thinset).

H. Metal Flooring Transitions: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.

I. Grout Sealer: Apply grout sealer to grout joints in tile floors in accordance with manufacturer's written instructions. As soon as sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 ADJUSTING AND CLEANING

A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile in accordance with tile and grout manufacturer's written instructions. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.5 PROTECTION

A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

END OF SECTION 093013

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SECTION 095123 - ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Acoustical tiles.
2. Metal suspension system.
3. Accessories.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Acoustical tiles.
2. Metal suspension system.
3. Accessories.

B. Samples: For each exposed product and for each color and texture specified, 6 inches (150 mm) in size.

C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:

1. Acoustical Tiles: Set of full-size Samples of each type, color, pattern, and texture.
2. Concealed Suspension-System Members: 6-inch- (150-mm-) long Sample of each type.
3. Exposed Moldings and Trim: Set of 6-inch- (150-mm-) long Samples of each type and color.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension-system members.
2. Structural members to which suspension systems will be attached.
3. Method of attaching hangers to building structure.
4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
5. Size and location of initial access modules for acoustical tile.
6. Items penetrating finished ceiling and ceiling-mounted items including the following:

    a. Lighting fixtures.
    b. Diffusers.
    c. Grilles.

d. Speakers.
e. Sprinklers.

B. Qualification Data: For testing agency.

C. Product Test Reports: For each acoustical tile ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.

D. Evaluation Reports: For each acoustical tile ceiling suspension system, from ICC-ES.

E. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Units: Full-size tiles equal to 2 percent of quantity installed.
2. Suspension-System Components: Quantity of each concealed grid and exposed component equal to 2 percent of quantity installed.

1.6 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup of typical ceiling area as shown on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical tiles, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical tiles, permit them to reach room temperature and a stabilized moisture content.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical tile ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical tile ceiling installation.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Source Limitations for Suspended Acoustical Tile Ceiling System: Obtain each type of acoustical ceiling tile and its suspension system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Class B in accordance with ASTM E1264.
2. Smoke-Developed Index: 450 or less.

2.3 ACOUSTICAL TILES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Armstrong World Industries.
2. CertainTeed; SAINT-GOBAIN.
3. USG Corporation.

B. Acoustical Tile Standard: Provide manufacturer's standard tiles of configuration indicated that comply with ASTM E1264 classifications as designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.

C. Classification: Provide tiles as follows:
1. ACT-1: Mineral Fiber (Basis of Design: USG Mars, Armstrong Ultima)
   a. Type and Form: Type IV, Form 1 and Form 2.
   b. Pattern: E (lightly textured) G (smooth).
   c. Color: White.
   d. Light Reflectance (LR): Not less than 0.89.
   e. Ceiling Attenuation Class (CAC): Not less than 35.
   f. Noise Reduction Coefficient (NRC): Not less than 0.70.
   g. Edge/Joint Detail: Square, kerfed, and rabbeted; tongue and grooved; or butt.
   h. Thickness: 3/4 inch (19 mm).

i. Modular Size: 24 by 24 inches.

2. ACT-2: Gypsum scrubbable base with vinyl base
   a. Type and Form: Type XX.
   b. Pattern: G (smooth).
   c. Color: White.
   d. Light Reflectance (LR): Not less than 0.77.
   e. Ceiling Attenuation Class (CAC): Not less than 35.
   f. Edge/Joint Detail: Square, kerfed, and rabbeted; tongue and grooved; or butt.
   g. Thickness: 1/2 inch.
   h. Modular Size: 24 by 24 inches.

2.4 METAL SUSPENSION SYSTEM

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. USG Corporation.
   a. Basis of Design: 15/16” Donn DX/DXL

B. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, fully concealed, metal suspension system and accessories of type, structural classification, and finish indicated that complies with applicable requirements in ASTM C635/C635M.

1. High-Humidity Finish: Where indicated, provide coating tested and classified for "severe environment performance" in accordance with ASTM C635/C635M.

C. Direct-Hung, Double-Web Suspension System: Main and cross runners roll formed from and capped with cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 (Z90) coating designation.

1. Structural Classification: Intermediate-duty system.

2.5 ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing in accordance with ASTM E488/E488M or ASTM E1512 as applicable, conducted by a qualified testing and inspecting agency.

   a. Type: Postinstalled expansion or Postinstalled bonded anchors.
   b. Corrosion Protection, Carbon Steel: Components zinc plated in accordance with ASTM B633, Class SC 1 (mild) service condition.

c. Corrosion Protection, Stainless Steel: Components complying with ASTM F593 and ASTM F594, Group 1 Alloy 304 or 316.

2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing in accordance with ASTM E1190, conducted by a qualified testing and inspecting agency.

B. Wire Hangers, Braces, and Ties: Provide wires as follows:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
2. Stainless Steel Wire: ASTM A580/A580M, Type 304, nonmagnetic.
3. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch- (2.69-mm-) diameter wire.

C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

D. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

E. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04-inch- (1-mm-) thick, galvanized-steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.

2.6 ACOUSTICAL SEALANT

A. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

2.7 MISCELLANEOUS MATERIALS

A. Acoustical Tile Adhesive: Type recommended in writing by acoustical tile manufacturer, bearing UL label for Class 0-25 flame spread.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing and substrates to which acoustical tile ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine acoustical tiles before installation. Reject acoustical tiles that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Testing Substrates: Before adhesively bonding tiles to wet-placed substrates such as cast-in-place concrete or plaster, test and verify that moisture level is below tile manufacturer's recommended limits.

B. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.

C. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION OF SUSPENDED ACOUSTICAL TILE CEILINGS

A. Install suspended acoustical tile ceilings in accordance with ASTM C636/C636M and manufacturer's written instructions.

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
7. Do not attach hangers to steel roof deck. Attach hangers to structural members.
8. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
9. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

C. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

D. Arrange directionally patterned acoustical tiles as follows:

1. As indicated on reflected ceiling plans.

E. Install acoustical tiles in coordination with suspension system and exposed moldings and trim. Place splines or suspension-system flanges into kerfed edges of tiles so tile-to-tile joints are interlocked.

1. Fit adjoining tiles to form flush, tight joints. Scribe and cut tiles for accurate fit at borders and around penetrations through ceiling.
2. Hold tile field in compression by inserting leaf-type, spring-steel spacers between tiles and moldings, spaced 12 inches (305 mm) o.c.
3. Protect lighting fixtures and air ducts in accordance with requirements indicated for fire-resistance-rated assembly.

3.4 ERECTION TOLERANCES

A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m), non-cumulative.

3.5 ADJUSTING

A. Clean exposed surfaces of acoustical tile ceilings, including trim and edge moldings. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

B. Remove and replace tiles and other ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095123

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SECTION 095753 - SECURITY CEILING ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Downward-locking-panel security ceiling assembly (ACT-3).

1.2 COORDINATION

A. Coordinate layout and installation of security ceiling assemblies with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Downward-locking-panel security ceiling assembly.

B. Samples for Verification: For the following products, of sizes indicated below:

1. Security Ceiling Panel Units: Full cross section by 12 inches (305 mm) long for each type of panel.
2. Perimeter Supports, Closures, and Exposed Molding: 12 inches (305 mm) long for each type.
3. Suspension System: 12 inches (305 mm) long.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Layout of panels, joint pattern, and transitions.
2. Suspension system members.
3. Method of attaching hangers to building structure.
4. Size and location of access panels.
5. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

B. Qualification Data: For Installer.

C. Product Test Reports: For each security ceiling assembly, for tests performed by a qualified testing agency.

D. Attachment Device Test Reports: Indicating capability to sustain, without failure, load indicated without pulling out from substrate.

E. Field quality-control reports.

F. Examination reports documenting inspection of substrates, areas, and conditions.

G. Anchor inspection reports documenting inspections of built-in and cast-in anchors.

H. Field quality-control certification signed by Contractor.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Security Ceiling Panels: Full-size units equal to 2 percent of amount installed.
2. Suspension System Components: Quantity of each grid and exposed component equal to 2 percent of amount installed.
3. Security Fasteners: Furnish not less than 1 box for each 50 boxes or fraction thereof, of each type and size of security fastener installed.
4. Tools: Provide two sets of tools for installing and removing security fasteners, packaged for easy handling and storage.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver security ceiling panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Handle security ceiling panels, suspension system components, and accessories carefully to avoid damaging units and finishes in any way.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Security ceiling assemblies to withstand normal thermal movement and structural loads without failure, including permanent deformation of security ceiling assembly components including pans and suspension system; noise or metal fatigue caused by vibration, deflection, and displacement of security ceiling units; and permanent damage to fasteners and anchors.

B. Acoustical Performance: Provide security ceiling assemblies with acoustical ratings indicated, as determined in accordance with ASTM E1264 and the following:

1. Noise Reduction Coefficient (NRC): ASTM C423 and ASTM E795 in Type E-400 mounting.
2. Ceiling Attenuation Class (CAC): ASTM E1414/E1414M.

a. Structural Performance: Security ceiling assemblies to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

2.2 DOWNWARD-LOCKING-PANEL SECURITY CEILING ASSEMBLY (ACT-3)

A. Downward-Locking-Panel Security Ceiling Assembly: Provide a complete, integrated assembly, including security ceiling panels, exposed suspension system, perimeter supports, and accessories.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Armstrong Ceiling & Wall Solutions.
1) Basis of Design: METALWORKS SecureLock

B. Panels: Fabricated from a single sheet of metal, with formed upturned edges on all four sides designed to continuously engage with and lock under rectangular bulb of suspension system.

1. Steel Panels: Metallic-coated steel with minimum uncoated sheet thickness of 0.043 inch (1.09 mm).
2. Panel Size: 24 by 24 inches (610 by 610 mm).
3. Perforation Pattern: Manufacturer's standard.
4. Noise Reduction Coefficient (NRC): 0.80.

C. Sound-Absorptive Pads: Provide sound-absorptive pads for placement over ceiling panels.

1. Spacer Grids: Metallic-coated-steel grid units that provide an air cushion between security ceiling panels and sound-absorptive pads and that act to improve sound absorption.

2. Support Clips: Metal clips designed to hold sound-absorptive pads above bottom face sheet.

D. Access Panels: Material, perforation pattern, and finish same as security ceiling panels; designed for installation by security fasteners screwed through suspension system. Provide panels at locations indicated on Drawings.

1. Size: 24 by 48 inches (610 by 1220 mm).

E. Suspension System: ASTM C635/C635M, heavy-duty exposed system consisting of snap-in main runners supported by hangers attached to building structure.

1. Provide system complete with main runners, splice plates, connector and alignment clips, hangers, trim, seismic- and wind-load clips and struts, and other suspension components required to support security ceiling units and other security ceiling-supported construction.
2. Main Runners and Cross Tees: Formed from metal sheet, 1-1/2 inches (38 mm) high, with 15/16-inch (23.8-mm) flange width and with oversized rectangular bulb for engaging panels.
3. Wire Hangers, Braces, and Ties: Zinc-coated, carbon-steel wire, ASTM A641/A641M, Class 1 zinc coating, soft temper.
    a. Size: Select wire diameter so its stress at 3 times the hanger design load (ASTM C635/C635M, Table 1, Direct Hung) will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.
4. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
5. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
6. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide, formed with 0.04-inch- (1.0-mm-) thick, galvanized-steel sheet, G90 (Z275) zinc coating, with bolted connections and 5/16-inch- (8-mm-) diameter bolts.
7. Compression Struts: Fabricated from 3/4-inch- (19-mm-) diameter steel tubing, designed to fit over rectangular bulb of suspension system.
8. Security Clips: Steel wire, designed to slip over suspension system and through holes in flanges of panel to prevent panel removal.

F. Perimeter Supports: Wall-mounted channel moldings and wall angles; fabricated from 0.042-inch- (1.06-mm-) thick galvanized steel; finished to match suspension system.

G. Exposed Edge Moldings and Trim: Provide exposed members as indicated or required for edges of security ceiling, fixture trim, beams, fasciae at changes in security ceiling height, and other conditions; of metal and finish matching security ceiling panels.

H. Materials:

1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, CS (Commercial Steel), Type B; uncoated or electrolytic zinc coated suitable for exposed applications.
2. Metallic-Coated Steel Sheet: ASTM A653/A653M, CS (Commercial Steel), Type B; with G60 (Z180) zinc (galvanized) or A60 (ZF180) zinc-iron-alloy (galvannealed) coating designation.

3. Steel Tubing: ASTM A513/A513M, Type B.

2.3 SOUND-ABSORPTIVE PADS

A. Plastic-Sheet-Wrapped, Mineral-Fiber Insulation: Pads consisting of nonrigid, vinyl chloride plastic sheet encapsulating unfaced mineral-fiber insulation.

1. Plastic Sheet: Not less than 0.003 inch (0.076 mm) thick; flat black.
2. Mineral Fiber: Glass fiber or fiber made from slag (mineral wool), complying with ASTM C553, Type I, II, or III.
3. Thickness: 1 inch (25 mm).
4. Mineral-Fiber Density: As required to meet NRC rating.
5. Surface-Burning Characteristics: As determined by testing identical products in accordance with ASTM E84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 25 or less.

2.4 FABRICATION

A. Panels: Form metal panels from sheet metals selected for their surface flatness, smoothness, and freedom from surface blemishes where exposed to view in finished unit. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, or variations in flatness exceeding those permitted by referenced standards for stretcher-leveled metal sheet.

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 METALLIC-COATED STEEL SHEET FINISHES

A. Surface Preparation: Clean surfaces of oil and other contaminants. Use cleaning methods that do not leave residue. After cleaning, apply a conversion coating compatible with the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and apply galvanizing repair paint, complying with SSPC-Paint 20, to comply with ASTM A780/A780M.

B. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils (0.05 mm).

1. Color and Gloss: As selected by Architect from manufacturer's full range.

2.7 STEEL FINISHES

A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning" or SSPC-SP 8, "Pickling".

B. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).

1. Color and Gloss: Manufacturer's standard white.

2.8 SECURITY FASTENERS

A. Security Fasteners for Ceiling Assemblies: Operable only by tools produced by fastener manufacturer or other licensed fabricator for use on specific type of fastener. Drive-system type, head style, material, and protective coating as required for assembly, installation, and strength, and as follows:

1. Drive-System Type: Pinned Torx-Plus.
2. Fastener Strength: 120,000 psi (827 MPa).
3. Socket Button Head Fasteners:

    a. Heat-treated alloy steel, ASTM F835.
    b. Stainless steel, ASTM F879 (ASTM F879M), Group 1 CW.

4. Socket Flat Countersunk Head Fasteners:

    a. Heat-treated alloy steel, ASTM F835.
    b. Stainless steel, ASTM F879 (ASTM F879M), Group 1 CW.

5. Socket Head Cap Fasteners:

    a. Heat-treated alloy steel, ASTM A574.
    b. Stainless steel, ASTM F837 (ASTM F837M), Group 1 CW.

6. Protective Coatings for Heat-Treated Alloy Steel:

    a. Zinc and clear trivalent chromium where indicated.
    b. Zinc phosphate with oil, ASTM F1137, Grade I, or black oxide unless otherwise indicated.

2.9 ACCESSORIES

A. Concealed Bolts: ASTM A307, Grade A unless otherwise indicated.

B. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for metal alloy welding.

C. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, Direct Hung, unless otherwise indicated.

D. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated in accordance with ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E488/E488M conducted by a qualified testing agency.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of security ceiling assemblies.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations of security ceiling assembly connections before security ceiling assembly installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of security ceiling assemblies.

D. Inspect built-in and cast-in anchor installations before installing security ceiling assemblies to verify that anchor installations comply with requirements. Prepare inspection reports.

1. Repair, or remove and replace, anchors where inspections indicate noncompliance with specified requirements. Reinspect after repair or replacement.
2. Perform additional inspections to determine compliance of replaced or additional work. Prepare inspection reports.

E. Verify locations and layouts of security ceiling assemblies with those indicated on reflected ceiling plans and coordination drawings.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordination: Furnish layouts for cast-in-place anchors, clips, and other security ceiling anchors whose installation is specified in other Sections.

1. Furnish cast-in-place anchors and similar devices to other trades for installation well in advance of time needed for coordinating other work.

B. Measure each security ceiling area and establish layout of security ceiling panels to balance border widths at opposite edges of each security ceiling. Avoid using less-than-half-width

panels at borders and comply with layout shown on reflected ceiling plans and coordination drawings.

3.3 GENERAL INSTALLATION

A. Comply with CISCA's "Ceiling Systems Handbook" for installation of security ceiling assemblies.

B. Install perimeter supports around perimeter of security ceiling area.

1. Do not use exposed fasteners, including pop rivets, on moldings and trim. If exposed fasteners are unavoidable, obtain prior written approval from Architect for their use and use security fasteners.

C. Install accessories where indicated and as required to comply with performance requirements.

1. Sound-Absorptive Pads: For security ceiling panels indicated, provide sound-absorptive pads of width and length to completely fill inside of each security ceiling panel.

a. Install sound-absorptive pads over metal spacer grids or with support clips.

3.4 INSTALLATION OF DOWNWARD-LOCKING-PANEL SECURITY CEILING ASSEMBLY

A. Ceiling Hangers: Suspend from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within security ceiling plenum that are not part of supporting structure or of security ceiling suspension system.
2. Splay hangers only where required to avoid obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to security ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
7. Do not attach hangers to steel deck tabs.
8. Do not attach hangers to steel roof deck. Attach hangers to structural members.

9. Space hangers not more than 48 inches (1220 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
10. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
11. Install compression struts extending from main runners to structure above and spaced at 48 inches (1220 mm) o.c.

B. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

C. Panel Installation: Install panels to continuously engage with and lock under rectangular bulb of suspension system. Attach panels to perimeter supports with security fasteners not more than 3 inches (76 mm) from edges of panel. Fasten through exposed face of supports into panel.

1. Align joints in adjacent courses to form uniform, straight joints parallel to room axis in both directions unless otherwise indicated.
2. Fit adjoining units to form flush, tight joints. Scribe and cut units for accurate fit at borders and around construction penetrating security ceiling.
3. Install directionally patterned panels in directions indicated.
4. Scribe and cut security ceiling panels for accurate fit at borders and at interruptions and penetrations by other work through security ceilings. Stiffen edges of cut panels as required to eliminate evidence of buckling or variations in flatness.

D. Access Panels: Install each access panel only where indicated and within one security ceiling panel.

E. Access Panels: Install each access panel only where indicated and within one security plank.

F. Provide steel angle reinforcement on each side of openings that exceed 12 inches (305 mm) in any direction.

3.5 FIELD QUALITY CONTROL

A. Inspect installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.

B. Remove and replace security ceiling assemblies where inspections indicate that work does not comply with specified requirements.

C. Perform additional inspections to determine compliance of replaced or additional work. Prepare inspection reports.

D. Prepare field quality-control certification that states installed products and their installation comply with requirements in the Contract Documents.

3.6 CLEANING

A. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented and bent units.

B. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as that used for shop painting; comply with SSPC-PA 1 for touching up shop-painted surfaces.

a. Apply by brush or spray to provide a minimum dry film thickness of 2 mils (0.05 mm).

2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

C. Metallic-Coated Steel Surfaces: Clean field welds, bolted connections, and abraded areas and repair zinc or zinc-iron coating to comply with ASTM A780/A780M.

END OF SECTION 095753

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Vinyl base.
2. Rubber molding accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches (300 mm) long.

C. Product Schedule: For resilient base and accessory products.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Coordinate mockups in this Section with mockups specified in other Sections.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.7 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 VINYL BASE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Johnsonite; a Tarkett company.

B. Product Standard: ASTM F1861, Type TV (vinyl, thermoplastic).

1. Group: I (solid, homogeneous).
2. Style and Location:

a. Style A, Straight: .

C. Minimum Thickness: 0.125 inch (3.2 mm).

D. Height: 4 inches (102 mm).

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Job formed.

G. Inside Corners: Job formed.

H. Colors and Patterns: Moonrock 29

2.2 RUBBER MOLDING ACCESSORY

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Roppe Corporation; Roppe Holding Company.
2. VPI Corporation.

B. Description: Rubber transition strips.

C. Profile and Dimensions: As indicated.

D. Locations: Provide rubber molding accessories in areas indicated.

E. Colors and Patterns: As selected by Architect from manufacturer's full range.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

C. Metal Edge Strips: Extruded aluminum with mill finish, nominal 2 inches (50.8 mm) wide, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
4. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft. (304.8 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

    a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient products until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.

a. Form without producing discoloration (whitening) at bends.

2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.

a. Miter or cope corners to minimize open joints.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Perform the following operations immediately after completing resilient-product installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum horizontal surfaces thoroughly.
3. Damp-mop horizontal surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, adhesive, and blemishes from resilient stair treads before applying liquid floor polish.

1. Apply one coat(s).

E. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

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SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Solid vinyl floor tile.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of resilient floor tile.

1. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
2. Show details of special patterns.

C. Samples: Full-size units of each color, texture, and pattern of floor tile required.

D. Product Schedule: For floor tile.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

1.9 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 SOLID VINYL FLOOR TILE

A. Basis od Design Product: Subject to compliance with requirements, provide product indicated on Drawings.

2.2 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

    a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles square with room axis.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles with grain running in one direction.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

H. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

END OF SECTION 096519

SECTION 096723.10 - RESINOUS FLOORING – BASE BID

PART 1 - GENERAL – BASIS OF DESIGN

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes resinous flooring system.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.

B. Samples for Verification: For each resinous flooring system required, 6 inches (150 mm) square, applied to a rigid backing by Installer for this Project.

C. Product Schedule: Use resinous flooring designations indicated in Part 2 and room designations indicated on Drawings in product schedule.

D. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

E. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. No request for substitution shall be considered that would change the generic type of floor system specified (i.e. epoxy mortar based system). Equivalent materials of other manufactures may be substituted only on approval of Architect or Engineer. Request for substitution will only be considered only if submitted 10 days prior to bid date. Request will be subject to specification requirements described in this section.

B. Installer Qualifications: Engage an experienced installer (applicator) who is experienced in applying resinous flooring systems similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance, and who is acceptable to resinous flooring manufacturer.
   1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.
   2. Contractor shall have completed at least 10 projects of similar size and complexity.

C. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, through one source from a single manufacturer,

with not less than ten years of successful experience in manufacturing and installing principal materials described in this section. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.

D. Manufacturer Field Technical Service Representatives: Resinous flooring manufacture shall retain the services of Field Technical Service Representatives who are trained specifically on installing the system to be used on the project.
   1. Field Technical Services Representatives shall be employed by the system manufacture to assist in the quality assurance and quality control process of the installation and shall be available to perform field problem solving issues with the installer.

E. Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Apply full-thickness mockups on 48-inch- (1200-mm-) square floor area selected by Architect.
      a. Include 48-inch (1200-mm) length of integral cove base.
   2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

F. Pre-installation Conference:
   1. General contractor shall arrange a meeting not less than thirty days prior to starting work.
   2. Attendance:
      a. General Contractor
      b. Architect/Owner's Representative.
      c. Manufacturer/Installer's Representative.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

B. Store materials to prevent deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.

C. All materials used shall be factory pre-weighed and pre-packaged in single, easy to manage batches to eliminate on site mixing errors. No on site weighing or volumetric measurements allowed.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
   1. Maintain material and substrate temperature between 65 and 85 deg F (18 and 30 deg C) during resinous flooring application and for not less than 24 hours after application.

B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.

C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application, unless manufacturer recommends a longer period.

D. Concrete substrate shall be properly cured for a minimum of 30 days. A vapor barrier must be present for concrete subfloors on or below grade. Otherwise, an osmotic pressure resistant grout must be installed prior to the resinous flooring

1.7 WARRANTY

A. Manufacturer shall furnish a single, written warranty covering both material and workmanship for a period of (1) full years from date of installation, or provide a joint and several warranty signed on a single document by material manufacturer and applicator jointly and severally warranting the materials and workmanship for a period of (1) full year from date of installation. A sample warranty letter must be included with bid package or bid may be disqualified.

PART 2 - PRODUCTS

2.1 RESINOUS FLOORING

A. Available Products: Build of Broadcast or liquid rich type systems will not be accepted, and will result in a disqualification from bid.

B. EPOX1
1. Products: Subject to compliance with requirements:
   a. Basis of Design: Stonhard, Inc.; Stonclad GS. With top coat Stonkote HT4.
2. System Characteristics:
   a. Color and Pattern: Choose from Mfg. Standards
   b. Wearing Surface: Standard smooth.
   c. Integral Cove Base: TBD inches.
   d. Overall System Thickness: 1/4”
3. System Components: Manufacturer’s standard components that are compatible with each other and as follows:
   a. Mortar Base:
      1) Material design basis: Stonclad GS
      2) Resin: Epoxy.
      3) Formulation Description: 100 percent solids.
      4) Application Method: Metal Trowel.
         a) Thickness of Coats: 1/4 inch (6.4 mm).
         b) Number of Coats: One.
      5) Aggregates: Pigmented Blended aggregate.
   b. Top coat: Stonkote® HT4, Chemical resistant
      1) Material design basis: Stonkote HT4
      2) Resin: Bisphenol F epoxy coating.
      3) Formulation Description: 100% solids.
      4) Type: pigmented.
      5) Finish: standard.
      6) Number of Coats: One.

4. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:

a. Compressive Strength: 10,000 psi after 7 days per ASTM C 579.
b. Tensile Strength: 1,750 psi per ASTM C 307.
c. Flexural Modulus of Elasticity: 4,000 psi per ASTM C 580.
d. Water Absorption: 0.2% per ASTM C 413.
e. Coefficient of Thermal Expansion: 1.5 x 10^{-5} mm/ ºC mm per ASTM C 531.
f. Impact Resistance: No chipping, cracking, or delamination and not more than 1/16-inch (1.6-mm) permanent indentation per MIL-D-3134.
g. Resistance to Elevated Temperature: No slip or flow of more than 1/16 inch (1.6 mm) per MIL-D-3134.
h. Abrasion Resistance: 0.08 gm maximum weight loss per ASTM D 4060.
i. Flammability: Self-extinguishing per ASTM D 635.
j. Hardness: 85 to 90, Shore D per ASTM D 2240.
k. Bond Strength: 400 psi, 100 percent concrete failure per ACI 503R.

2.2 ACCESSORY MATERIALS

A. Primer: Type recommended by manufacturer for substrate and body coats indicated. Formulation Description: Stonhard Standard Primer, 100% solids.

B. Waterproofing Membrane: Type recommended by manufacturer for substrate and primer and body coats indicated. Formulation Description Only if application above grade Stonproof ME7.

C. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

D. Joint Sealant: Type recommended or produced by resinous flooring manufacturer for type of service and joint condition indicated. Allowances should be included for Stonflex MP7 joint fill material, and CT5 concrete crack treatment.

PART 3 - EXECUTION

3.1 PREPARATION

A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry, and neutral Ph substrate for resinous flooring application.

B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
1. Mechanically prepare substrates as follows:
a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
b. Comply with ASTM C 811 requirements, unless manufacturer's written instructions are more stringent.
2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written recommendations.
3. Verify that concrete substrates are dry.

a. Perform in situ probe test, ASTM F 2170. Proceed with application only after substrates do not exceed a maximum potential equilibrium relative humidity of 75 percent.
b. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application only after substrates have maximum moisture-vapor-emission rate of 7 lb of water/1000 sq. ft. of slab in 24 hours.
c. Perform additional moisture tests recommended by manufacturer. Proceed with application only after substrates pass testing.

4. Verify that concrete substrates have neutral Ph and that resinous flooring will adhere to them. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.

C. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

D. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

E. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written recommendations. Allowances should be included for Stonflex MP7 joint fill material, and CT5 concrete crack treatment.

3.2 APPLICATION

A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
3. At substrate expansion and isolation joints, provide joint in resinous flooring to comply with resinous flooring manufacturer's written recommendations.
a. Apply joint sealant to comply with manufacturer's written recommendations.

B. Apply primer where required by resinous system, over prepared substrate at manufacturer's recommended spreading rate.

A. Integral Cove Base: Stonclad® GS mortar, apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.
1. Integral Cove Base: TBD inches high.

B. Apply metal trowel single mortar coat in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When cured, sand to remove trowel marks and roughness.

C. Apply topcoat(s) in number of coats indicated for flooring system and at spreading rates recommended in writing by manufacturer.

3.3 FIELD QUALITY CONTROL

A. Material Sampling: Owner may at any time and any numbers of times during resinous flooring application require material samples for testing for compliance with requirements.
   1. Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
   2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
   3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.

3.4 CLEANING, PROTECTING, AND CURING

A. Cure resinous flooring materials in compliance with manufacturer's directions, taking care to prevent contamination during stages of application and prior to completion of curing process. Close area of application for a minimum of 18 hours.

B. Protect resinous flooring materials from damage and wear during construction operation. Where temporary covering is required for this purpose, comply with manufacturer's recommendations for protective materials and method of application. General Contractor is responsible for protection and cleaning of surfaces after final coats.

C. Cleaning: Remove temporary covering and clean resinous flooring just prior to final inspection. Use cleaning materials and procedures recommended by resinous flooring manufacturer

END OF SECTION 096723

SECTION 096723.20 - RESINOUS FLOORING – ALTERNATE BID

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Resinous flooring.
2. Integral cove base accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's technical data, installation instructions, and recommendations for each resinous flooring component required.

B. Samples: For each resinous floor system required and for each color and texture specified, 6 inches (150 mm) square in size, applied to a rigid backing by Installer for this Project.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Material Certificates: For each resinous flooring component.

C. Material Test Reports: For each resinous flooring system, by a qualified testing agency.

D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Apply full-thickness mockups on 96-inch- (2400-mm-) square floor area.

a. Include 96-inch (2400-mm) length of integral cove base with inside corner.

2. Simulate finished lighting conditions for Architect's review of mockups.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring installation.

B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring installation.

C. Close spaces to traffic during resinous flooring installation and for 24 hours after installation unless manufacturer recommends a longer period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Flammability: Self-extinguishing in accordance with ASTM D635.

2.2 RESINOUS FLOORING

A. Resinous Flooring System: Abrasion-, impact-, and chemical-resistant, aggregate-filled, resin-based monolithic floor surfacing designed to produce a seamless floor and integral cove base.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Sherwin-Williams High Performance Flooring.
        1) Basis of Design: Resuflor Déco Quartz BC23

B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Obtain secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.

C. System Characteristics:

1. Color and Pattern: As selected by Architect from manufacturer's full range.
2. Wearing Surface: Textured for slip resistance.
3. Overall System Thickness: 1/8 inch (3.2 mm).

D. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested in accordance with test methods indicated:

1. Compressive Strength: 12,000 psi minimum in accordance with ASTM C579.
2. Tensile Strength: 2,500 psi minimum in accordance with ASTM C307.
3. Flexural Modulus of Elasticity: 4,500 psi minimum in accordance with ASTM C580.
4. Impact Resistance: No chipping, cracking, or delamination and not more than 1/16-inch (1.6-mm) permanent indentation in accordance with MIL-D-3134J.
5. Resistance to Elevated Temperature: No slip or flow of more than 1/16 inch (1.6 mm) in accordance with MIL-D-3134J.
6. Abrasion Resistance: 90-100 mgs maximum weight loss in accordance with ASTM D4060.
7. Hardness: 70/65, Shore D in accordance with ASTM D2240.

E. Primer: Type recommended in writing by resinous flooring manufacturer for substrate and resinous flooring system indicated.

1. Products:

    a. Basis of Design: Resuprime 3579.

2. Formulation Description: High solids.

F. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended in writing by manufacturer for installation indicated.

G. Body Coats:

1. Products:

    a. Basis of Design: Resuflor 3561.

2. Formulation Description: High solids.
3. Type: Pigmented.
4. Installation Method: Self-leveling slurry with broadcast aggregates.
5. Number of Coats: Two.
6. Aggregates: Manufacturer's standard.

H. Grout Coat:

1. Products:

a. Basis of Design: Resuflor 3746.

2. Formulation Description: High solids.
3. Type: Pigmented.

I. Topcoats: Sealing or finish coats.

1. Products:

a. Basis of Design: Resuflor 3746.
1) Provide alternate pricing for Urethane topcoat.

2. Formulation Description: High solids.
3. Number of Coats: One.
4. Finish: Matte.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resinous flooring systems.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare and clean substrates in accordance with resinous flooring manufacturer's written instructions for substrate indicated to ensure adhesion.

B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.

1. Roughen concrete substrates as follows:

a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.

2. Repair damaged and deteriorated concrete in accordance with resinous flooring manufacturer's written instructions.
3. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft. (304.8 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

C. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates in accordance with manufacturer's written instructions.

D. Resinous Materials: Mix components and prepare materials in accordance with resinous flooring manufacturer's written instructions.

3.3 INSTALLATION

A. Apply components of resinous flooring system in accordance with manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness specified.

1. Coordinate installation of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
2. Cure resinous flooring components in accordance with manufacturer's written instructions. Prevent contamination during installation and curing processes.
3. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.

B. Primer: Apply primer over prepared substrate at spreading rate recommended in writing by manufacturer.

C. Field-Formed Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring coats. Apply in accordance with manufacturer's written instructions and details, including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.

1. Integral Cove Base: 6 inches high.

D. Self-Leveling Body Coats: Apply self-leveling slurry body coats in thickness specified for flooring system.

1. Aggregates: Broadcast aggregates at rate recommended in writing by manufacturer. After resin is cured, remove excess aggregates to provide surface texture indicated.

E. Troweled or Screeded Body Coats: Apply troweled or screeded body coats in thickness specified for flooring system. Hand or power trowel and grout to fill voids. When body coats are cured, remove trowel marks and roughness using method recommended in writing by manufacturer.

F. Grout Coat: Apply grout coat to fill voids in surface of final body coat.

G. Topcoats: Apply topcoats in number indicated for flooring system specified, at spreading rates recommended in writing by manufacturer, and to produce wearing surface specified.

3.4 FIELD QUALITY CONTROL

A. Material Sampling: Owner may, at any time and any number of times during resinous flooring installation, require material samples for testing for compliance with requirements.

1. Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reinstall flooring materials to comply with requirements.

3.5 PROTECTION

A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION 096723

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Modular carpet tile.

B. Related Requirements:

1. Section 096513 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Include manufacturer's written installation recommendations for each type of substrate.

B. Shop Drawings: For carpet tile installation, plans showing the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Type of installation.
3. Pattern of installation.
4. Pattern type, location, and direction.
5. Type, color, and location of insets and borders.
6. Type, color, and location of edge, transition, and other accessory strips.
7. Transition details to other flooring materials.

C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.

D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.

C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with the Carpet and Rug Institute's CRI 104.

1.9 FIELD CONDITIONS

A. Comply with the Carpet and Rug Institute's CRI 104 for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.10 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, the following:

a. More than 10 percent edge raveling, snags, and runs.
b. Dimensional instability.
c. Excess static discharge.
d. Loss of tuft-bind strength.
e. Loss of face fiber.
f. Delamination.

3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings.

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.

B. Examine carpet tile for type, color, pattern, and potential defects.

C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.

1. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft. (304.8 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

   a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
   b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
   c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.

C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: As recommended in writing by carpet tile manufacturer.

C. Maintain dye-lot integrity. Do not mix dye lots in same area.

D. Maintain pile-direction patterns recommended in writing by carpet tile manufacturer.

E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

H. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.
3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with the Carpet and Rug Institute's CRI 104, Section 13.7.

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

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SECTION 099100 - PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes surface preparation and the application of paint systems on interior and exterior substrates.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for shop priming of metal substrates with primers specified in this Section.

1.3 DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. Samples for Initial Selection: For each type of topcoat product.

C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches (200 mm) square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
3. VOC content.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.6 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Sherwin-Williams Company (The).
2. Benjamin Moore & Co.
3. Diamond Vogel Paints.
4. ICI Paints.
5. PPG Architectural Finishes, Inc.
6. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 100 g/L.
3. Primers, Sealers, and Undercoaters: 100 g/L.
4. Floor Coatings: 100 g/L.

D. Colors: As indicated in a color schedule.

2.3 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Masonry (Clay and CMU): 12 percent.
3. Wood: 15 percent.
4. Gypsum Board: 12 percent.
5. Plaster: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Plaster Substrates: Verify that plaster is fully cured.

E. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

F. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:

1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."
3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

I. Aluminum Substrates: Remove loose surface oxidation.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in occupied spaces:

a. Equipment, including panelboards.
b. Uninsulated metal piping.
c. Uninsulated plastic piping.
d. Pipe hangers and supports.
e. Metal conduit.
f. Plastic conduit.
g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
h. Other items as directed by Architect.

2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

A. Ferrous Metal, Zinc-Coated Metals, Aluminum :
1. Primer coat: Rust-inhibitive waterborne self-cross-linking acrylic primer.
   a. Minimum DFT: 2.0 mils (over iron and steel).
   b. Minimum VS: 39 percent.
   c. S-W: Pro-Cryl Universal Primer B66.
2. 2-component acrylic polyurethane high gloss:
   a. 1 finish coat.
   b. Minimum DFT: 4.0 mils.
   c. Minimum VS: 57 percent.
   d. Sheen: 30 to 50 units at 60 degrees.
   e. S-W: Acrolon 218 HS Acrylic Polyurethane Semigloss B65.

3.7 INTERIOR PAINTING SCHEDULE

A. Concrete Masonry Units:
1. Walls:
   a. Blockfiller: Latex-based, blockfiller:
      1) Minimum DFT: 8 mils.
      2) Minimum VS: 48 percent.
      3) Apply 2 coats if required by substrate.
      4) S-W: PrepRite Blockfiller B25W25.
   b. Low-luster acrylic-latex, interior enamel:
      1) 2 finish coats.
      2) Minimum DFT: 1.6 mils.
      3) Minimum VS: 37 percent.
      4) Sheen: 10 to 20 units at 85 degrees.
      5) S-W: ProMar 200 Latex Eg-Shel B20W, 1200 series.
2. Unconditioned spaces, electrical/ mechanical rooms:
   a. Blockfiller: High-performance, latex-based, blockfiller:
      1) Minimum DFT: 8 mils.
      2) Minimum VS: 48 percent.
      3) Apply 2 coats if required by substrate.
      4) S-W: ProMar Blockfiller B25W25.
   b. Semigloss, acrylic-latex, interior enamel.
      1) 2 finish coats.
      2) Mild alkali and acid resistance.
      3) Minimum DFT: 2.6 mils.

4) Minimum VS: 36 percent.
5) Sheen: 35 to 55 at 60 degrees.
6) S-W: Metalatex Semi-Gloss B42 Series.

3. Walls – Epoxy (Decon Rooms):
   a. Primer
      1) S-W: Loxon Block Surfacer A24W200
   b. Intermediate
      1) High-Performance Epoxy B67-200
   c. Topcoat
      1) High Performance Epoxy B67-200

B. Gypsum Board:
1. Walls:
   a. Primer: Vinyl acrylic:
      1) Minimum DFT: 1.1 mils.
      2) Minimum VS: 26 percent.
      3) S-W: PrepRite 200 Latex Wall Primer B28W200.
      4) S-W: For plaster, use Loxon Interior Acrylic Masonry Primer B28W300.
   b. Low-luster, acrylic-latex, interior enamel (typical):
      1) 2 finish coats.
      2) Minimum DFT: 1.6 mils per coat.
      3) Minimum VS: 37 percent.
      4) Sheen: 10 to 20 units at 85 degrees.
      5) S-W: ProMar 200 Latex Eg-Shel B20W, 1200 Series.
2. Ceilings:
   a. Primer: Latex-based, interior primer.
      1) Minimum DFT: 1.1 mils.
      2) Minimum VS: 26 percent.
      3) S-W: PrepRite 200 Latex Wall Primer B28W200.
   b. Flat, vinyl acrylic interior paint.
      1) 2 finish coats.
      2) Minimum DFT: 1.2 mils per coat.
      3) Minimum VS: 37 percent.
      4) Sheen: 0 to 5 units at 85 degrees.
      5) S-W: ProMar 400 Flat Latex B30W400 Series.
3. Unconditioned spaces and mechanical rooms:
   a. Primer: Latex-based, interior primer.
      1) Minimum DFT: 1.1 mils.
      2) Minimum VS: 26 percent.
      3) S-W: PrepRite 200 Latex Wall Primer B28W200.
      4) S-W: For plaster, use Loxon Interior Acrylic Masonry Primer B28W300.
   b. Semigloss, acrylic-latex, interior enamel.
      1) 2 finish coats.
      2) Minimum DFT: 2.6 mils.
      3) Minimum VS: 36 percent.
      4) Sheen: 35 to 55 units at 60 degrees.
      5) S-W: Metalatex Semi-Gloss B42 Series.

C. Ferrous and Zinc-Coated Metal:
1. Primer: Quick-drying, rust-inhibitive, waterborne, self-cross-linking acrylic primer:
   a. Minimum DFT: 2.0 mils.

b. Minimum VS: 39.
c. S-W: Pro-Cryl Universal Primer B66.

2. Semigloss, alkyd-enamel odorless finish:
a. 2 finish coats.
b. Minimum DFT: 3.4 mils.
c. Minimum VS: 43 percent.
d. Sheen: 40 to 50 units at 60 degrees.
e. S-W: ProMar Alkyd Semi-Gloss B34W200 Series.

D. Exposed Overhead Metal (Structural Steel, Joists, Decks):
1. Dryfall waterborne system; semigloss acrylic finish.
a. Spot Primer: Rust-inhibitive waterborne self-cross-linking acrylic primer:
b. Minimum DFT: 2.0 mils.
c. Minimum VS: 39 percent.
d. S-W: Pro-Cryl Universal Primer B66_310.

2. Waterborne flat acrylic dryfall.
a. 1 finish coat.
b. Minimum DFT: 3.0 mils.
c. Minimum VS: 40 percent.
d. Sheen: 0 to 5 units at 85 degrees.
e. S-W: Waterborne Acrylic Dryfall B42W1.

END OF SECTION 099100

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SECTION 101419 – DIMENSIONAL LETTER SIGNAGE

PART 1 GENERAL

1.1 SUMMARY

A. Provide:

1. Dimensional letters and numbers.
    a. Cast metal:
        1) Aluminum.
2. Signage accessories including, but not limited to:
    a. Fasteners.

B. Related Sections:

1. Section 101423 - Panel Signage

1.2 REFERENCES

A. ANSI A117.1 - Information Systems

1.3 COORDINATION

A. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.4 DEFINITIONS

A. Illuminated: Illuminated by lighting source integrally constructed as part of the sign unit.

1.5 SUBMITTALS

A. Reference: Refer to Section 01 33 00.

B. Product Data: Submit manufacturer's current Product Data including specifications, installation instructions, and maintenance recommendations.

C. Shop Drawings: Submit manufacturer's Shop Drawings showing system installation drawings, including elevations, sections details of components, and configurations within system and between system and adjoining system.

D. Samples:

1. Color Samples: Submit manufacturer's full range of color samples with Product Data and Shop Drawings.
2. Font Samples: Submit example of font indicated, or if not indicated, manufacturer's standard fonts.

1.6 QUALITY ASSURANCE

A. Single Source Responsibility: Provide signage units made of components of standard construction furnished by one manufacturer as coordinated assemblies for each system.

B. Qualifications:

1. Manufacturer: 5 years experience in the manufacture of signage.
2. Contractor: 3 years experience in the installation of signage.
3. Personnel: For actual installation of signage, use personnel skilled in work required, completely familiar with manufacturer's recommended methods of installation, thoroughly familiar with requirements of work.

C. Field Samples: Submit manufacturer's standard letter in style and font selected. If approved, this sample may be installed as part of the required identifying devices.

D. Regulations Requirements:

1. Comply with applicable provisions in:
   a. ICC.
   b. ANSI A117.1.
   c. OSHA.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Dimensional Characters:

1. Cast Metal:

a. Standard of Quality: Design is based on products of Metal Arts Company, Mandan, ND www.metalartslettersandplaques.com

b. Other Acceptable Manufacturers: Subject to compliance with specified requirements, acceptable manufacturers and products are:

1) A.R.K. Ramos, Oklahoma City, OK www.arkramos.com

2) Gemini, Inc., Decorah, IA www.geminiletters.com

3) Metallic Arts, Inc., Spokane, WA www.metallicarts.com

4) Manufacturer of comparable products submitted in compliance with Section 012513.

2.2 COMPONENTS

A. Cast Characters: Characters with uniform faces, sharp corners, and precisely formed lines and profiles, and as follows:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. ACE Sign Systems, Inc.
   b. APCO Graphics, Inc.
   c. ASI Sign Systems, Inc.
   d. Gemini Incorporated.
   e. Matthews International Corporation; Bronze Division.
   f. Metal Arts; Division of L & H Mfg. Co.
2. Character Material: Aluminum casting.
3. Character Height: As indicated on drawings.
4. Thickness: Manufacturer's standard for size of character.
5. Finishes:
   a. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color as selected by Architect from manufacturer's full range.
   b. Overcoat: Manufacturer's standard baked-on clear coating.
   c. Painted Edges: Paint edges of acrylic characters with laminated metal facing as recommended in writing by manufacturer.
6. Mounting: Concealed studs, projected from surface.
7. Typeface: Verify with Architect.
8. Illumination System: Halo-lit reverse channel letters.
   a. Provide products that are listed and labeled as complying with UL 879, where applicable.
   b. Power: 120V, 60Hz, 1 phase, 15A.

B. Other Materials: Other materials not specifically described but required for complete, proper installation of signage are subject to acceptance of Architect.

PART 3 EXECUTION

3.1 EXAMINATION

A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.

B. Verification of Conditions: Verify that identifying devices may be installed in accordance with original design, pertinent codes and regulations, and pertinent portions of referenced standards.

C. Discrepancies: Immediately notify Architect. Do not proceed with installation in areas of discrepancy until fully resolved. Commencement of installation signifies acceptance of surface conditions.

3.2 INSTALLATION

A. Use standard fastening methods recommended in writing by manufacturer for character form, type of mounting, wall construction, and condition of exposure indicated.

B. Provide heavy paper template to establish character spacing and to locate holes for fasteners.

C. Install plumb, true, square in neat, rigid, substantial manner.

D. Vinyl mounting surface shall be clean and free of dust and debris.

3.3 CLEANING AND PROTECTION

A. After installation, clean all surfaces.

B. Protect from damage until acceptance by Owner.

3.4 SCHEDULE

A. Provide the following:
   1. Dimensional Letters and Numbers:
      a. 16 inches high.
      b. Font: TBD
      c. Text: FIRE DEPARTMENT
      d. Illuminated
   2. Dimensional Letters and Numbers:
      a. 16 inches high.
      b. Font: TBD
      c. Text: PUBLIC SAFETY CENTER
      d. Non-Illuminated

B. Location: Verify with Architect.

END OF SECTION

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SECTION 101423 - PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Provide:
   1. Panel signs and frames:
      a. Room identification signs.
      b. Accessible spaces signs.
      c. Room Capacity Sign

B. Section does not include:
   1. Dimensional letters and numbers (Section 101419).

C. Related Sections:
   1. Section 101419 - Dimensional Letter Signage and Plaques

1.2 REFERENCES

A. Industry Standards:
   1. ADA Accessibility Standards
   2. ANSI A117.1 - Information Systems
   3. ICC 1003.2 - Accessibility and Exit Signs
   4. ICC 1005.3.2.4 - Stairway Signs
   5. OSHA

1.3 SUBMITTALS

A. Refer to the Division 1 Specifications.

B. Product Data: Submit manufacturer’s current Product Data including construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of sign.

C. Shop Drawings: Submit Shop Drawings showing elevations, large-scale sections of typical members and other components, mounting methods, grounds, mounting heights, layout, spacing, reinforcement, accessories, and installation details.

D. Samples:
   1. Color Samples: Submit manufacturer’s standard color samples with Product Data and Shop Drawings.
   2. Font Samples: Submit example of font indicated, or if not indicated, manufacturer’s standard fonts.
   3. Pictogram: Submit example of each symbol indicated.

1.4 QUALITY ASSURANCE

A. Single Source Responsibility: Provide interior signage systems made of components of standard construction furnished by one manufacturer as coordinated assemblies for each system.

B. Qualifications:
   1. Manufacturer: 5 years experience in the manufacture of interior signage.

C. Certifications:
   1. Submit certification that signage meets handicapped standards specified.
   2. Submit independent certification that Braille is correct for stated text.

D. Field Samples: Submit manufacturer's sample for each signage system in style, color and font selected. If approved, this sample may be installed as part of the required signage.

E. Regulations Requirements:
   1. Comply with applicable provisions in:
      a. ADA-ABA Accessibility Guidelines.
      b. ICC.
      c. ANSI A117.1.
      d. OSHA.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Acceptable Manufacturers: Subject to compliance with requirements, acceptable manufacturers and products are:
   1. ASI Sign Systems, Inc. www.asimodulex.com
   2. Braille-Tac Division of Advance Corporation, Cottage Grove, MN www.brailletacsigns.com
   3. Mohawk Sign Systems www.mohawksign.com
   4. Poblocki Sign Company, West Allis, WI www.poblocki.com
   5. Sign Solutions www.signsolutions.ie
   6. Creative Sign Company Inc., De Pere, WI www.greenbaysigns.com
   7. Manufacturer of comparable products submitted in compliance with Division 1 Specifications.

2.2 MATERIALS AND FABRICATION

A. Panel Signs:
   1. Provide panel signs that comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.
   2. Sign surface shall remain flat under installed conditions within tolerance of plus or minus 1/16 inch measured diagonally.
   3. Frames:
      a. Material: Injection molded high impact styrene.
      b. Style: Radius corners.

c. Finish: Colors selected by Architect from manufacturer's standard color palette.

4. Insert Panels:
   a. Meet requirements of ADA.
   b. Materials: Modified acrylic.
   c. Size: As indicated as scheduled.
   d. Graphic process: Raised copy; 1/32-inch minimum.
   e. Lettering: Upper case characters in size as indicated on the Drawings, or if not indicated, 5/8-inch (minimum), 2 inches (maximum).
   f. Font: Helvetica Medium.
   g. Braille: Include text (grade 2).
   h. Finish: ADA compliant matte finish in colors selected by Architect from manufacturer's standard color palette.
   i. Pictogram: As indicated by text on 6-inch high (minimum) background.

B. Panel Signage Types (See attached Drawings at end of section):

PART 3 - EXECUTION

3.1 EXAMINATION

A. Work of Other Trades: Prior to commencing work, carefully inspect and verify that work is complete to point where this installation may properly commence.

B. Verification of Conditions: Verify that interior signage may be installed in accordance with original design, pertinent codes and regulations, and pertinent portions of referenced standards.

C. Discrepancies: Immediately notify Architect. Do not proceed with installation in areas of discrepancy until fully resolved. Commencement of installation signifies acceptance of surface conditions.

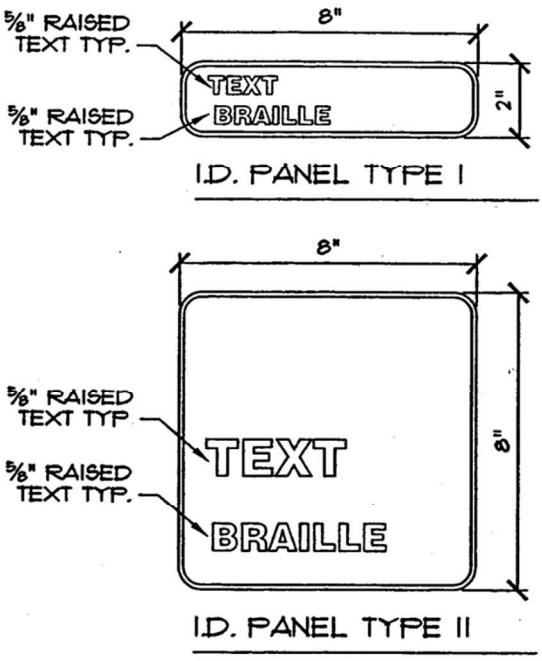
3.2 INSTALLATION

A. Install plumb, true, square in neat, rigid, substantial manner.

B. Comply with ADA.

C. Install in compliance with manufacturer's written instructions.

D. Sign surfaces shall be free from distortion and other defects in appearance.



E. Location:
1. Install signs on walls adjacent to latch side of door where applicable.
2. Where not indicated or possible, install signs on nearest adjacent walls.
3. Locate to allow approach within 3 inches of sign without encountering protruding objects or standing within swing of door.

F. Mounting System:
1. Frame: Concealed screw mount.
2. Insert Panel: 3M Brand, No. 468 High Performance tape.

3.3 CLEANING

A. After installation, clean all surfaces.

3.4 SCHEDULE

A. See Panel Types for rooms that require signage.
1. Panel Type I: Typical rooms that require signage
   a. Offices, training, storage, and water rooms
2. Panel Type II: Typical rooms that require signage
   a. Toilet and locker rooms.

B. Room Capacity Sign: (1) 12x7 sign in Training Room 104 noting Room Capacity. Sign to say " MAXIMUM OCCUPANCY 85 PERSONS"

END OF SECTION

SECTION 102600 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Corner guards.

B. Related Requirements:

1. Section 087100 "Door Hardware" for metal protective trim units, according to BHMA A156.6, used for armor, kick, mop, and push plates.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For each type of wall and door protection showing locations and extent.

C. Samples for Initial Selection: For each type of impact-resistant wall-protection unit indicated, in each color and texture specified.

1. Include Samples of accent strips and accessories to verify color selection.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type of exposed plastic material.

B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.

1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Corner-Guard Covers: Full-size plastic covers of maximum length equal to 2 percent of each type, color, and texture of cover installed, but no fewer than two, 48-inch- (1200-mm-) long units.
2. Mounting and Accessory Components: Amounts proportional to the quantities of extra materials. Package mounting and accessory components with each extra material.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1. Maintain room temperature within storage area at not less than 70 deg F (21 deg C) during the period plastic materials are stored.
2. Keep plastic materials out of direct sunlight.
3. Store plastic wall- and door-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F (21 deg C).

    a. Store corner-guard covers in a vertical position.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
    b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain wall- and door-protection products from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Surface Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1.

2.3 CORNER GUARDS

A. Surface-Mounted, Metal Corner Guards: Fabricated as one piece from formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Babcock-Davis.
b. Balco; a CSW Industrials Company.
c. Nystrom, Inc.

2. Material: Stainless-steel sheet, Type 304.

a. Thickness: Minimum 0.0500 inch (1.3 mm).
b. Finish: Directional satin, No. 4.

3. Wing Size: Nominal 1-1/2 by 1-1/2 inches (38 by 38 mm).
4. Corner Radius: 1/8 inch (3 mm).
5. Mounting: Adhesive.

2.4 MATERIALS

A. Adhesive: As recommended by protection product manufacturer.

2.5 FABRICATION

A. Fabricate wall and door protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.

B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

C. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.6 FINISHES

A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.

1. For wall and door protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing wall and door protection.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

B. Mounting Heights: Install wall and door protection in locations and at mounting heights indicated on Drawings.

C. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.

1. Provide anchoring devices and suitable locations to withstand imposed loads.
2. Where splices occur in horizontal runs of more than 20 feet (6.1 m), splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches (305 mm) apart.
3. Adjust end caps as required to ensure tight seams.

3.4 CLEANING

A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.

B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 102600

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SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Public & Private-use washroom accessories.
2. Childcare accessories.
3. Custodial accessories.

B. Related Requirements:

1. Section 093013 "Ceramic Tiling" for ceramic toilet and bath accessories.
2. Section 102813.63 "Detention Toilet Accessories" for accessories designed for installation in detention facilities.

1.2 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Public & Private-use washroom accessories.
2. Childcare accessories.
3. Custodial accessories.

B. Product Data Submittals: For each product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.

C. Samples: For each exposed product and for each finish specified, full size.

1. Approved full-size Samples will be returned and may be used in the Work.

D. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify accessories using designations indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For accessories to include in maintenance manuals.

1.6 WARRANTY

A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, visible silver spoilage defects.
2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 OWNER-FURNISHED MATERIALS

A. Owner-Furnished Materials: Wall mounted Soap Dispenser (11), Paper Towel Dispenser (9), Toilet Tissue Dispenser (7).

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Design accessories and fasteners to comply with the following requirements:

1. Grab Bars: Installed units are able to resist 250 lbf (1112 N) concentrated load applied in any direction and at any point.
2. Shower Seats: Installed units are able to resist 250 lbf (1112 N) concentrated load applied in any direction and at any point.

2.3 PUBLIC & PRIVATE-USE WASHROOM ACCESSORIES

A. Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer.

B. Grab Bar (2, 3, 4, 5, 6):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. American Specialties, Inc.
    b. Bobrick Washroom Equipment, Inc.
    c. Bradley Corporation.
    d. GAMCO Specialty Accessories; a division of Bobrick.

2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.

    a. Finish: Smooth, ASTM A480/A480M No. 4 finish (satin).

4. OD: 1-1/2 inches (38 mm).
5. Configuration and Length: As indicated on Drawings.

C. Shelf (32):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Bradley Corporation.

2. Description: Basis of Design: Bradley Corporation, Elvari Shelf w/ Hooks.
3. Length: 24 inches.
4. Depth: 8 inches.
5. Hooks: Two.
6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

D. Mirror Unit (10):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. American Specialties, Inc.
    b. Bobrick Washroom Equipment, Inc.
    c. Bradley Corporation.
    d. GAMCO Specialty Accessories; a division of Bobrick.

2. Frame: Stainless steel channel.

    a. Corners: Manufacturer's standard.

3. Size: As indicated on Drawings.
4. Hangers: Manufacturer's standard rigid, tamper and theft resistant.

E. Shower Curtain and Rod (14):

1. Shower Rod:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1) American Specialties, Inc.
2) Bobrick Washroom Equipment, Inc.
3) Bradley Corporation.
4) GAMCO Specialty Accessories; a division of Bobrick.

a) Description: 1-1/4-inch- (32-mm-) OD, straight rod.

b. Configuration: As indicated on Drawings.
c. Mounting Flanges: Concealed fasteners; in manufacturer's standard material and finish.
d. Rod Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

2. Shower Curtain:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1) American Specialties, Inc.
2) Bobrick Washroom Equipment, Inc.
3) Bradley Corporation.

a) Size: Minimum 12 inches (305 mm) wider than opening by 72 inches (1829 mm) high.

b. Material: Nylon-reinforced vinyl, minimum 9 oz. (255 g) or 0.008-inch- (0.2-mm-) thick vinyl, with integral antibacterial and flame-retardant agents.

1) Color: As selected from manufacturer's full range.

c. Grommets: Corrosion resistant at minimum 6 inches (152 mm) o.c. through top hem.
d. Shower Curtain Hooks: Chrome-plated or stainless steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.

F. Folding Shower Seat (12):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. American Specialties, Inc.
b. Bobrick Washroom Equipment, Inc.

2. Configuration: Rectangular seat.

3. Seat: Phenolic or polymeric composite of slat-type or one-piece construction in color as selected by Architect.
4. Mounting Mechanism: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

G. Toiletries Shelf (35):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. American Specialties, Inc.

2. Basis of Design: ASI Sundries Shelf 7381
3. Description: Wire shelf basket.
4. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

H. Robe Hook (13):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. American Specialties, Inc.
   b. Bobrick Washroom Equipment, Inc.
   c. Bradley Corporation.
   d. GAMCO Specialty Accessories; a division of Bobrick.

2. Description: Single-prong unit.
3. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

2.4 CHILDCARE ACCESSORIES

A. Source Limitations: Obtain childcare accessories from single source from single manufacturer.

B. Diaper-Changing Station (34):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. American Specialties, Inc.
   b. GAMCO Specialty Accessories; a division of Bobrick.
   c. Koala Kare Products.

2. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.

   a. Engineered to support minimum of 250 lb (113 kg) static load when opened.

3. Mounting: Surface mounted, with unit projecting not more than 4 inches (102 mm) from wall when closed.

4. Operation: By pneumatic shock-absorbing mechanism.
5. Material and Finish: HDPE in manufacturer's standard color.
6. Liner Dispenser: Provide built-in dispenser for disposable sanitary liners.

2.5 CUSTODIAL ACCESSORIES

A. Source Limitations: Obtain custodial accessories from single source from single manufacturer.

B. Mop and Broom Holder (31):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. American Specialties, Inc.
   b. Bobrick Washroom Equipment, Inc.
   c. Bradley Corporation.

2. Description: Unit with holders.
3. Length: 36 inches (914 mm).
4. Mop/Broom Holders: Four, spring-loaded, rubber hat, cam type.
5. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

2.6 MATERIALS

A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.031-inch- (0.8-mm-) minimum nominal thickness unless otherwise indicated.

B. Brass: ASTM B19, flat products; ASTM B16/B16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B30, castings.

C. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch- (0.9-mm-) minimum nominal thickness.

D. Galvanized-Steel Sheet: ASTM A653/A653M, with G60 (Z180) hot-dip zinc coating.

E. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.

F. Fasteners: Screws, bolts, and other devices of same material as accessory unit, unless otherwise recommended by manufacturer or specified in this Section, and tamper and theft resistant where exposed, and of stainless or galvanized steel where concealed.

G. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).

H. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.7 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories in accordance with manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

1. Remove temporary labels and protective coatings.

B. Grab Bars: Install to comply with specified structural-performance requirements.

C. Shower Seats: Install to comply with specified structural-performance requirements.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Clean and polish exposed surfaces in accordance with manufacturer's written instructions.

END OF SECTION 102800

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SECTION 102813.63 - DETENTION TOILET ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Grab bars.

B. Related Requirements:

1. Section 102800 "Toilet, Bath, and Laundry Accessories" for nondetention toilet accessories.

1.3 COORDINATION

A. Coordinate installation of anchorages for detention toilet accessories. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in adjoining construction. Deliver such items to Project site in time for installation.

B. Coordinate size and location of recesses in wall construction to receive recessed detention toilet accessories.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples for Verification: For each type of detention toilet accessory indicated.

1. Approved full-size Samples will be returned and may be used in the Work.

C. Product Schedule: For detention toilet accessories. Indicate types, quantities, sizes, and installation locations by room of each accessory required.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Location of each built-in anchor supporting detention toilet accessories, including anchors to be installed as work of other Sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Locations, dimensions, and profiles of wall and floor reinforcements.
2. Locations and installation details of built-in anchors.
3. Elevations of each detention toilet accessory showing dimensions of accessory, preparations for receiving anchors, and locations of anchorage.
4. Details of attachment of each detention toilet accessory to built-in anchors.

B. Examination reports documenting inspection of substrates, areas, and conditions.

C. Anchor inspection reports documenting inspections of built-in and cast-in anchors.

D. Field quality-control certification signed by Contractor.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For detention toilet accessories to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Security Fasteners: Furnish not less than 1 box for each 50 boxes or fraction thereof, of each type and size of security fastener installed.
2. Tools: Provide two sets of tools for installing and removing security fasteners.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace detention toilet accessories that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including deflection exceeding 1/4 inch (6.3 mm).
b. Faulty operation of hardware.
c. Deterioration of metals, metal finishes, and other materials.

2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 DETENTION GRAB BARS (29)

A. Grab Bars: 1-1/2 inches (38.1 mm) in diameter; formed from 0.038-inch- (0.95-mm-) thick, stainless-steel tubing, with 3-inch- (76.2-mm-) diameter flanges formed from 0.125-inch- (3.18-mm-) thick, stainless steel. Closure plates formed from 0.125-inch- (3.18-mm-) thick, stainless steel. All-welded construction.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Bradley Corporation.

2. Length: As indicated on Drawings.
3. Mounting: Front mounting with security fasteners.

B. Materials:

1. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A666 or ASTM A240/A240M, austenitic stainless steel, Type 304.
2. Stainless-Steel Tubing: ASTM A1016/A1016M, austenitic stainless steel, Type 304, seamless.

C. Stainless-Steel Finish:

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finish: Grind and polish surfaces to produce uniform finish, free of cross scratches.

a. Run grain of directional finishes with long dimension of each piece.
b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
c. Directional Satin Finish: No. 4.

2.2 FABRICATION

A. Coordinate dimensions and attachment methods of detention toilet accessories with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.

B. Shear and punch metals cleanly and accurately. Remove burrs.

C. Form edges and corners to be free of sharp edges and rough areas. Fold back exposed edges of unsupported sheet metal to form a 1/2-inch- (12.7-mm-) wide hem on the concealed side, or ease edges to a radius of approximately 1/32 inch (0.8 mm) and support with concealed stiffeners.

D. Form metal in maximum lengths to minimize joints. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Weld corners and seams continuously to comply with referenced AWS standard 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 no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
5. Weld before finishing components to greatest extent possible. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure detention toilet accessories rigidly in place and to support expected loads. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce formed-metal units as needed to attach and support other construction.

G. Cut, reinforce, drill, and tap detention toilet accessories to receive hardware, security fasteners, and similar items.

H. Form exposed work true to line and level with accurate angles and surfaces. Grind off and ease edges unless otherwise indicated.

I. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed security fasteners of type indicated or, if not indicated, flat-head (countersunk) security fasteners. Locate joints where least conspicuous.

2.3 SECURITY FASTENERS

A. Operable only by tools produced by fastener manufacturer or other licensed fabricator for use on specific type of fastener. Drive-system type, head style, material, and protective coating as required for assembly, installation, and strength, and as follows:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Acument Global Technologies, Inc.; Acument Intellectual Properties, LLC.
b. Bryce Fastener Mfg., Inc.

2. Drive-System Type: Pinned Torx-Plus.
3. Fastener Strength: 120,000 psi (827 MPa).
4. Socket Button Head Fasteners:

a. Heat-treated alloy steel, ASTM F835.

b. Stainless steel, ASTM F879 (ASTM F879M), Group 1 CW.

5. Socket Flat Countersunk Head Fasteners:

a. Heat-treated alloy steel, ASTM F835.
b. Stainless steel, ASTM F879 (ASTM F879M), Group 1 CW.

6. Socket Head Cap Fasteners:

a. Heat-treated alloy steel, ASTM A574.
b. Stainless steel, ASTM F837 (ASTM F837M), Group 1 CW.

7. Protective Coatings for Heat-Treated Alloy Steel:

a. Zinc and clear trivalent chromium where indicated.
b. Zinc phosphate with oil, ASTM F1137, Grade I, or black oxide unless otherwise indicated.

2.4 ACCESSORIES

A. Concealed Bolts: ASTM A307, Grade A unless otherwise indicated.

B. Embedded Plate Anchors: Fabricated from mild steel shapes and plates, minimum 3/16 inch (4.8 mm) thick; with minimum 1/2-inch- (12.7-mm-) diameter, headed studs welded to back of plate.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of detention toilet accessories.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations of detention toilet accessory connections before detention toilet accessory installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of detention toilet accessories.

D. Inspect built-in and cast-in anchor installations before installing detention toilet accessories to verify that anchor installations comply with requirements. Prepare inspection reports.

1. Remove and replace anchors where inspections indicate that they do not comply with specified requirements. Reinspect after repairs or replacements are made.
2. Perform additional inspections to determine compliance of replaced or additional work. Prepare inspection reports.

E. Verify locations of detention toilet accessories.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing detention toilet accessories to in-place construction. Include threaded fasteners for masonry inserts, security fasteners, and other connectors.

B. Provide temporary bracing or anchors in formwork for items that are to be built into masonry or similar construction.

C. Security Fasteners: Install detention toilet accessories using security fasteners with head style appropriate for installation requirements, strength, and finish of adjacent materials. Provide stainless-steel security fasteners in stainless-steel materials.

D. Grab Bars: Install to withstand a downward load of not less than 250 lbf (1112 N) per ASTM F446.

3.3 FIELD QUALITY CONTROL

A. Inspect installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.

B. Remove and replace detention work where inspections indicate that work does not comply with specified requirements.

C. Perform additional inspections to determine compliance of replaced or additional work. Prepare inspection reports.

D. Prepare field quality-control certification that states installed products and their installation comply with requirements in the Contract Documents.

3.4 ADJUSTING AND CLEANING

A. Remove temporary labels and protective coatings.

B. Touchup Painting: Immediately after erection, clean 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 for touching up shop-painted surfaces.

C. Touchup Painting: Cleaning and touchup painting of bolted connections and abraded areas of shop paint are specified in Section 099123 "Interior Painting."

END OF SECTION 102813.63

SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-protection cabinets for the following:

a. Portable fire extinguisher.

B. Related Requirements:

1. Section 104416 "Fire Extinguishers" for portable, hand-carried fire extinguishers accommodated by fire-protection cabinets.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.

B. Shop Drawings: For fire-protection cabinets.

1. Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each type of exposed finish required.

D. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semirecessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.

2.3 FIRE-PROTECTION CABINET

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Babcock-Davis.
2. Guardian Fire Equipment, Inc.
3. JL Industries; Activar Construction Products Group, Inc.
4. Larsen's Manufacturing Company.
5. Nystrom, Inc.

B. Fire-Protection Cabinet Type: Suitable for fire extinguisher.

C. Cabinet Construction: Nonrated.

D. Cabinet Material: Cold-rolled steel sheet.

E. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).

1. Rolled-Edge Trim: 2-1/2-inch (64-mm) backbend depth.

F. Cabinet Trim Material: Steel sheet.

G. Door Material: Steel sheet.

H. Door Style: Fully glazed panel with frame.

I. Door Glazing: Tempered float glass (clear).

J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide projecting door pull and friction latch.
2. Provide continuous hinge, of same material and finish as trim,, permitting door to open 180 degrees.

K. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.

    a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."

        1) Location: Applied to cabinet glazing.
        2) Application Process: Decals.
        3) Lettering Color: White.
        4) Orientation: Vertical.

L. Materials:

1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.

    a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
    b. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    c. Color: As selected by Architect from manufacturer's full range.
2. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.4 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Miter corners and grind smooth.
3. Provide factory-drilled mounting holes.
4. Prepare doors and frames to receive locks.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.
2. Miter and weld perimeter door frames and grind smooth.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire-protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION OF FIRE-PROTECTION CABINETS

A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at height indicated below:

1. Fire-Protection Cabinet Mounting Height: 42 inches (1067 mm) above finished floor to top of fire extinguisher.

B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Provide inside latch and lock for break-glass panels.
2. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

C. Identification:

1. Apply decals at locations indicated.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.

E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

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SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

B. Related Requirements:

1. Section 104413 "Fire Protection Cabinets."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.5 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of hydrostatic test according to NFPA 10 when testing interval required by NFPA 10 is within the warranty period.
b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Babcock-Davis.
b. JL Industries; Activar Construction Products Group, Inc.
c. Kidde; Carrier Global Corporation.
d. Larsen's Manufacturing Company.
e. Nystrom, Inc.

2. Valves: Manufacturer's standard.
3. Handles and Levers: Manufacturer's standard.
4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.

B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A:60-B:C, 10-lb (4.5-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.3 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Babcock-Davis.
    b. JL Industries; Activar Construction Products Group, Inc.
    c. Kidde; Carrier Global Corporation.
    d. Larsen's Manufacturing Company.
    e. Nystrom, Inc.

2. Source Limitations: Obtain mounting brackets and fire extinguishers from single source from single manufacturer.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

    a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

1. Mounting Height: Top of fire extinguisher to be at 42 inches (1067 mm) above finished floor.

END OF SECTION 104416

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SECTION 105030 - TURNOUT GEAR LOCKERS – WALL MOUNTED

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Design, fabrication and installation of wall mounted turnout gear lockers as specified herein.

1.2 RELATED SECTIONS

A. Section 10: Metal Lockers

B. Sections of Division 16: electrical as applicable.

1.3 SUBMITTALS

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

B. Shop Drawings: Submit manufacturer’s shop drawings for each individual run of lockers.

C. Samples: Submit manufacturer’s standard color samples.

D. Owner’s Manual: Provide maintenance manual at closeout.

E. Warranty: Submit manufacturer’s standard warranty.

1.4 QUALITY ASSURANCE

A. Manufacturer shall have a minimum of five years experience in the direct manufacture of lockers.

B. Installer shall have experience in locker installation.

1.5 DELIVERY, STORAGE AND HANDLING

A. Delivery: Deliver materials to site in manufacturer’s original, unopened containers with labels identifying product and manufacturer’s name.

B. Storage: Store materials in a clean dry area.

C. Handling: Protect materials and finish during installation and handling to prevent damage.

PART 2 - PRODUCTS – BASIS OF DESIGN

2.1 MANUFACTURER

A. A.Mid-Minnesota Wire (GearGrid Product Line), 670 SW 15th Street, Forest Lake, MN 55025. Toll-free 888-643-6694. Phone 651-464-4468. Fax 651-464-4780. Web site www.geargrid.com. Email sales@geargrid.com.

2.2 TURNOUT GEAR LOCKERS

A. Model: GEARGRID Wall Mounted Storage System

B. Locker Sizes:
   1. Jumbo 24” Opening: Overall dimension-79” high x 25.25 wide x 20” deep.
      a. Clear Opening Width: 22.75”

C. Construction: Units shall be welded at all applicable joints. Forming of metal shall be completed by standard cold-forming operations. Use of fasteners will only be required to allow for knock-down shipping, securing units to mounting surface and on applicable accessories.

D. Vertical Dividers:
   1. Outer Frames: 1.25” O.D. x 16 gauge wall thickness ASTM A513 steel tubing.
   2. Inner Grid: .25” diameter ASTM 510 cold drawn steel wire resistance welded to a 3” square pattern.

E. Back Panel:
   1. Grid: .25” diameter ASTM 510 cold drawn steel wire resistance welded to a 3” square pattern.

F. Shelves: (1) Top, (1) Bottom. .25” diameter ASTM 510 cold drawn steel wire resistance welded and cold formed. Top shelf includes a 20 gauge steel bracket to accept a 2” x 16” name placard.

G. Apparel Hooks: (3) per opening. .25” diameter ASTM 510 cold drawn steel wire resistance welded and cold formed.

2.3 ACCESSORIES

A. Horizontal Hang Bar:
   1. Tube: 1.25”O.D. x 16 gauge 304 stainless steel tubing.
   2. Brackets: Attach to side mesh, powder coated.

B. Coat Drying Hanger:
   1. .25” diameter 304 stainless steel wire cold formed and resistance welded.
   2. Black vinyl coating on hook end.

C. Glove Drying Hanger:
   1. .25” diameter 304 stainless steel wire cold formed and resistance welded.
   2. Black vinyl coating on hook end.

D. Helmet Holder:
   1. .25” diameter ASTM 510 cold drawn steel wire resistance welded.

E. Gear Box:
   1. 6” x 6” x 12” long 6061 Aluminum with door one end.

F. Power Bar
   1. 1 duplex receptacle location for each locker.

2.4 FINISH

A. General: All system components excluding assembly and mounting hardware and stainless steel components are to receive the standard finish.

B. Standard Finish: Components to be cleaned using a phosphatized bath, clear water rinse and electro-statically coated with a durable TGIC powder coating.

C. Color: To be selected by Architect from manufacturer’s full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive lockers. Notify architect if areas are not acceptable. Do not begin installation until unacceptable conditions have been corrected.

3.2 INSTALLATION

A. A.Install lockers in accordance with manufacturer’s instructions.

B. Use manufacturer’s hardware for assembly.

C. Anchor to mounting surface with proper hardware.

END OF SECTION 105030

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SECTION 105113 - METAL LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Welded lockers.
2. Locker benches.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker and bench.

B. Shop Drawings: For metal lockers.

1. Include plans, elevations, sections, and attachment details.
2. Show locker trim and accessories.
3. Include locker identification system and numbering sequence.

C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. The following metal locker hardware items equal to 10 percent of amount installed for each type and finish installed, but no fewer than five units:

a. Blank identification plates.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.

1.8 COORDINATION

A. Coordinate sizes and locations of bases for metal lockers.

B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures.
b. Faulty operation of latches and other door hardware.

2. Damage from deliberate destruction and vandalism is excluded.
3. Warranty Period for Welded Metal Lockers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain metal lockers and accessories from single source from single locker manufacturer.

1. Obtain locks from single lock manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: For lockers and locker benches indicated to be accessible, comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

2.3 METAL LOCKER ROOM LOCKER (16)

A. Lockers shall be "First Responder Series" as manufactured by DeBourgh Mfg. Co. or approved equal.

B. Model #: HERL442-1

C. Size: 24 x 24 x 73”

D. Door: 24” Wide, Single Door

E. Color: As selected by Architect from Manufacturer’s full range.

F. Body of Lockers:
1. Top and Bottom constructed of 18 gauge cold rolled sheet steel. Include 4 gang electrical knockout at rear center of unit top.
2. Exterior sides constructed of 18 gauge cold rolled sheet steel.
3. Backs constructed of 18 gauge cold rolled sheet steel welded to frames of sides and intermediate partitions.
4. Sides and Back to have 4 inch on center supports for reconfigurable interior components.
5. Continuous Door Strike on all four sides of door opening.

G. Doors:
1. Constructed of 16 gauge steel, formed outer panel with double bends on both sides and a single bend on top and bottom of 18 gauge steel formed stiffener panel.
2. 16 gauge stiffener runs top to bottom between ventilation. Stiffener is securely welded to outer door to form a reinforced channel. Stiffener to be perforated with 3/16” holes to act as a pegboard.
3. Door to be louvers with six louvers at the top and bottom, providing 7% ventilation per square inch of ventilated area.
4. Sentry I Tree-Point / Three-sided Cremone Latch with Fascia
   a. Latching mechanism operated cremone style with an 11 gauge padlock hasp that will accept a padlock.
   b. Latching rods, 3/8 inch diameter, engage top and bottom edge of locker frame. 3/16 inch thick center latch engages door jamb.
   c. Rubber bumpers riveted to door stops.
5. 1 ½ inch open x 16 gauge CRS continuous hinge welded to side of the door and riveted to the locker frame.

H. Filler Panels:
1. Manufacturer’s standard fabricated from 18 gauge solid steel painted to match lockers.

I. Finish:
1. Complete locker unit to be cleaned, phosphatized and sealed.

2. Finish is back powder coat with a minimum 2-3 mil thickness.

J. Accessories:
1. Full width shelf
2. Security box, 12”W x 15”D x 12”H.
3. (4) wall hooks with full width clothes rod.

K. Base: 2x treated wood base, see detail on drawings

2.4 CORRIDOR & DECON LOCKERS (15)

A. Lockers shall be "Welded Gen2" as manufactured by Penco Products or approved equal.

B. Size: 12 x 12 x 60”

C. Door: 12” Wide, 3 Tiered

D. Ventilation: Standard Louvers

E. Base: 2x treated wood base, see detail on drawings.

F. Color: As selected by Architect from Manufacturer’s full range.

2.5 METAL DUTY WEAR LOCKER (36)

A. Lockers shall be "FreeStyle Personal Storage with built-in bench drawers" as manufactured by Spacesaver Corporation or approved equal.

B. Size: 24 x 24 x 72”

1. Door: 24” Wide, Single Door
2. Bench drawer: 36 inches deep

C. Body of Lockers:

1. The welded frame must consists of top, bottom, back, and sides constructed of a minimum of 18-gauge steel. All frame components shall be joined using resistance welding.
2. Horizontal front flanges will be a minimum of 2 inches. Vertical front flanges will be a minimum of 1 inch. Horizontal and vertical flanges will overlap and be secured with a minimum of (2) resistance welds per corner.
3. Corner gussets shall be MIG and spot welded in each of the four front corners of the locker.
4. Provide side panel lances evenly spaced on 3 inch centers.
5. Bench housing to have welded frame construction with minimum 1 inch horizontal and vertical flanges.

D. Doors:

1. Formed from (2) pieces of minimum 18-gauge cold rolled steel box formed and welded together.
2. External door panel shall be constructed with formed flanges and return flanges. Internal door panel shall be constructed with formed flanges.
   a. Single-piece welded door frame shall consist of internal door panel nested inside exterior door panel and welded.
3. Internal door panel to have pegboard style hole pattern and 4 inch rectangular slot centered towards the top of the locker.
4. 16 gauge stiffener runs top to bottom between ventilation. Stiffener is securely welded to outer door to form a reinforced channel. Stiffener to be perforated with 3/16" holes to act as a pegboard.
5. Provide louvered air vents in door.
6. Provide neoprene silencers
7. Provide 16-gauge, full length hinge, welded to door frame.
8. Padlock has lock option

E. Drawers:

1. Drawer body wrapper shall be formed from single piece consisting of sides and bottom, with back secured using structural locking lances.
2. Drawer shall be have box-formed drawer front.
3. Provide a flush mounted pull handle.
4. Provide louvered air vents in built-in bench drawer front.
5. Provide interlock system for securing drawer when main locker door is closed and provide access only when main locker door is opened.

F. Bench Seat:

1. Provide 9.5 inch deep, 1.25 inch thick kiln dried maple bench seat

G. End and Filler Panels:

1. Manufacturer's standard fabricated solid steel painted to match lockers.
2. End panels with no exposed fasteners shall be provided on the end of each run.

H. Finish:

1. Color to be selected by Architect from Manufacturer's full range.
2. Factory applied electrostatic powder coat paint.

I. Accessories:

1. Full width, plain shelf
2. 12" Modular Shelf with Backstop
3. Boot Tray
4. Hanger-Bar Assembly Kit
5. Hook Bracket Hanger Assembly Kit
6. Duplex power receptacle

J. Electrical System:

1. UL listed manufactured electrical wiring system with plug-in-play component design.
2. Standard 20 amp duplex receptacles

2.6 METAL SQUAD BAG LOCKER (37)

A. Lockers based on " Gear Locker & FreeStyle Personal Storage with built-in bench drawers" as manufactured by Spacesaver Corporation or approved equal.

B. Size: 24 x 24 x 84”

1. Bench drawer: 36 inches deep

C. Body of Lockers:

1. The welded frame must consists of top, bottom, back, and sides constructed of a minimum of 18-gauge steel. All frame components shall be joined using resistance welding.
2. Horizontal front flanges will be a minimum of 2 inches. Vertical front flanges will be a minimum of 1 inch. Horizontal and vertical flanges will overlap and be secured with a minimum of (2) resistance welds per corner.
3. Corner gussets shall be MIG and spot welded in each of the four front corners of the locker.
4. Provide side panel lances evenly spaced on 3 inch centers.
5. Bench housing to have welded frame construction with minimum 1 inch horizontal and vertical flanges.

D. Drawers:

1. Drawer body wrapper shall be formed from single piece consisting of sides and bottom, with back secured using structural locking lances.
2. Drawer shall be have box-formed drawer front.
3. Provide a flush mounted pull handle.
4. Provide louvered air vents in built-in bench drawer front.

E. Bench Seat:

1. Provide 9.5 inch deep, 1.25 inch thick kiln dried maple bench seat

F. End and Filler Panels:

1. Manufacturer’s standard fabricated solid steel painted to match lockers.
2. End panels with no exposed fasteners shall be provided on the end of each run.

G. Finish:

1. Color to be selected by Architect from Manufacturer’s full range.
2. Factory applied electrostatic powder coat paint.

H. Accessories:

1. Full width, plain shelves

2. Boot Tray

2.7 METAL WEAPONS LOCKER (38)

A. Lockers shall be "FreeStyle Personal Storage with built-in bench drawers" as manufactured by Spacesaver Corporation or approved equal.

B. Size: 36 x 24 x 84”

1. Door: 24” Wide, Double Door
2. Bench drawer: 36 inches deep

C. Body of Lockers:

1. The welded frame must consists of top, bottom, back, and sides constructed of a minimum of 18-gauge steel. All frame components shall be joined using resistance welding.
2. Horizontal front flanges will be a minimum of 2 inches. Vertical front flanges will be a minimum of 1 inch. Horizontal and vertical flanges will overlap and be secured with a minimum of (2) resistance welds per corner.
3. Corner gussets shall be MIG and spot welded in each of the four front corners of the locker.
4. Provide side panel lances evenly spaced on 3 inch centers.
5. Bench housing to have welded frame construction with minimum 1 inch horizontal and vertical flanges.

D. Doors:

1. Formed from (2) pieces of minimum 18-gauge cold rolled steel box formed and welded together.
2. External door panel shall be constructed with formed flanges and return flanges. Internal door panel shall be constructed with formed flanges.
   a. Single-piece welded door frame shall consist of internal door panel nested inside exterior door panel and welded.
3. Internal door panel to have pegboard style hole pattern and 4 inch rectangular slot centered towards the top of the locker.
4. 16 gauge stiffener runs top to bottom between ventilation. Stiffener is securely welded to outer door to form a reinforced channel. Stiffener to be perforated with 3/16” holes to act as a pegboard.
5. Provide louvered air vents in door.
6. Provide neoprene silencers
7. Provide 16-gauge, full length hinge, welded to door frame.

E. Drawers:

1. Drawer body wrapper shall be formed from single piece consisting of sides and bottom, with back secured using structural locking lances.
2. Drawer shall be have box-formed drawer front.
3. Provide a flush mounted pull handle.
4. Provide louvered air vents in built-in bench drawer front.

F. Bench Seat:

1. Provide 9.5 inch deep, 1.25 inch thick kiln dried maple bench seat

G. End and Filler Panels:

1. Manufacturer's standard fabricated solid steel painted to match lockers.
2. End panels with no exposed fasteners shall be provided on the end of each run.

H. Finish:

1. Color to be selected by Architect from Manufacturer's full range.
2. Factory applied electrostatic powder coat paint.

I. Accessories:

1. Weapons storage back panel

J. Lock:

1. Digilock Keypad

2.8 LOCKS

A. Combination Padlock: Provided by Owner.

2.9 LOCKER BENCHES

A. Provide bench units with overall assembly height of 17-1/2 inches (445 mm).

B. Bench Tops: Manufacturer's standard one-piece units, with rounded corners and edges.

1. Size: Minimum 20- to 24-inch- (508- to 610-mm-) wide tops where accessible benches are indicated.

C. Fixed-Bench Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top and anchoring to floor, complete with fasteners and anchors, and as follows:

1. Tubular Steel:

a. 1-1/2-inch- (38-mm-) diameter steel tubing threaded on both ends, with standard pipe flange at top and bell-shaped cast-iron base; with baked-enamel or powder-coat finish; anchored with exposed fasteners.
b. Color: As selected by Architect from manufacturer's full range.

D. Materials:

1. Stainless Steel Plate, Sheet, and Strip: ASTM A240/A240M or ASTM A666, Type 304.
2. Plastic Laminate: NEMA LD 3, Grade HGP.

3. Extruded Aluminum: ASTM B221 (ASTM B221M), alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated.
4. Steel Tube: ASTM A500/A500M, cold rolled.
5. Particleboard: ANSI A208.1, Grade M-2.

2.10 FABRICATION

A. Fabricate metal lockers square, rigid, without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.

1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.
2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.

B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments.

C. Equipment: Provide each locker with an identification plate.

D. Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections; with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds smooth and flush.

E. Continuous Sloping Tops: Fabricated in lengths as long as practical, without visible fasteners at splice locations; finished to match lockers.

1. Sloping-top corner fillers, mitered.

F. Recess Trim: Fabricated with minimum 2-1/2-inch (64-mm) face width and in lengths as long as practical; finished to match lockers.

G. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.

H. Finished End Panels: Fabricated to conceal unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

1. Provide one-piece panels for double-row (back-to-back) locker ends.

I. Center Dividers: Full-depth, vertical partitions between bottom and shelf; finished to match lockers.

2.11 ACCESSORIES

A. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.

B. Anchors: Material, type, and size required for secure anchorage to each substrate.

1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls, and elsewhere as indicated, for corrosion resistance.
2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and floors or support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install lockers level, plumb, and true; shim as required, using concealed shims.

1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches (910 mm) o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
2. Anchor single rows of metal lockers to walls near top and bottom of lockers.
3. Anchor back-to-back metal lockers to floor.

B. Welded Lockers: Connect groups together with manufacturer's standard fasteners, with no exposed fasteners on face frames.

C. Equipment:

1. Identification Plates: Identify metal lockers with identification indicated on Drawings.

    a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
    b. Attach plates to upper shelf of each open-front metal locker, centered, with a least two aluminum rivets.

D. Trim: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.

1. Attach recess trim to recessed metal lockers with concealed clips.
2. Attach filler panels with concealed fasteners. Locate filler panels where indicated on Drawings.
3. Attach sloping-top units to metal lockers, with closures at exposed ends.
4. Attach finished end panels using fasteners only at perimeter to conceal exposed ends of nonrecessed metal lockers.

E. Fixed Benches: Provide no fewer than two pedestals for each bench, uniformly spaced not more than 72 inches (1830 mm) apart. Securely fasten tops of pedestals to undersides of bench tops, and anchor bases to floor.

3.3 ADJUSTING

A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding.

3.4 PROTECTION

A. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.

B. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 105113

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SECTION 107300 – TRANSLUCENT FIBERGLASS SANDWICH PANEL CANOPY SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the structural canopy system as shown and specified. Work includes providing and installing:

1. Structural aluminum box beam superstructure
2. Factory prefabricated structural insulated translucent sandwich panels
3. Aluminum installation system

1.2 SUBMITTALS

A. Submit manufacturer's product data. Include construction details, material descriptions, profiles and finishes of components.

B. Submit shop drawings. Include plans, elevations and details.

C. Submit manufacturer's color charts showing the full range of colors available for factory finished exposed aluminum.

1. When requested, submit samples for each exposed finish required, in same thickness and material indicated for the work and in size indicated below.

a. Sandwich panels**:** 7" x 12" units
b. Factory finished aluminum: 3" long sections

D. Submit Installer Certificate, signed by installer, certifying compliance with project qualification requirements.

E. Submit product reports from a qualified independent testing agency indicating each type and class of panel system comply with the project performance requirements, based on comprehensive testing of current products. Previously completed reports will be acceptable for current manufacturers and indicative of products used on this project.

1. Reports required (if applicable) are:
   a. Flame Spread and Smoke Developed (UL 723) – Submit UL Card
   b. Burn Extent (ASTM D 635)
   c. Color Difference (ASTM D 2244)
   d. Impact Strength (UL 972)
   e. Bond Tensile Strength (ASTM C 297 after aging by ASTM D 1037)
   f. Bond Shear Strength (ASTM D 1002)
   g. Beam Bending Strength (ASTM E 72)
   h. Insulation U-Factor (NFRC 100)
   i. Fire Penetration of Exterior Wall Assemblies Using a Direct Flame Impingement Exposure (ASTM E2707)

j. Fall Through Resistance (ASTM E 661)
k. Class A Roof Covering Burning Brand (UL 790)

1.3 CLOSEOUT SUBMITTALS

A. Provide project maintenance manuals.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Material and products shall be manufactured by a company continuously and regularly employed in the manufacture of specified materials for a period of at least ten consecutive years and which can show evidence of those materials being satisfactorily used on at least six projects of similar size, scope and location. At least three of the projects have been in successful use for ten years or longer.
2. Panel system must be listed by an ANSI accredited Evaluation Service, which requires quality control inspections and fire, structural and water infiltration testing of sandwich panel systems by an accredited agency.
3. Quality control inspections shall be conducted at least once each year and shall include manufacturing facilities, sandwich panel components and production sandwich panels for conformance with AC177 "Translucent Fiberglass Reinforced Plastic (FRP) Faced Panel Wall, Roof and Skylight Systems" as issued by the ICC-ES.

B. Single Source: Obtain primary and secondary components and structural framing members, translucent fiberglass roof panels, clips, closures, and other accessories from a single manufacturer to operate as a complete system for the intended use.

C. Installer's Qualifications: Installation shall be by an experienced installer, which has been in the business of installing specified panel systems for at least two consecutive years and can show evidence of satisfactory completion of projects of similar size, scope and type.

1.5 PERFORMANCE REQUIREMENTS

A. The manufacturer shall be responsible for the configuration and fabrication of the complete canopy system, including the aluminum box beam superstructure.

1. When requested, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

2. Structural Loads; Provide canopy system capable of handling the following loads:

a. Roof Live Load, on horizontal projected surface: 20 PSF
b. Roof Snow Load, on horizontal projected surface: 31 PSF
c. Roof Snow Drift Load, on horizontal projected surface: 23 PSF (wall mounted), 44 PSF (standalone)
d. Base Wind Load: 25 PSF

B. Deflection Limits:

1. Canopy Panels: Limited to l/60 of clear span.

C. Thermal Movements: Allow for thermal movements from ambient- and surface-temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 110 deg F (43 deg C), ambient; 150 deg F (66 deg C), material surfaces.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver canopy system, components and materials in manufacturer's standard protective packaging.

B. Store canopy system panels on the long edge; several inches above the ground, blocked and under cover in accordance with manufacturer's storage and handling instructions.

1.7 WARRANTY

A. Provide manufacturer's and installer's written warranty agreeing to repair or replace canopy system work, which fails in material or workmanship within one year from the date of delivery. Failure of material or workmanship shall include deterioration of finish on metal in excess of normal weathering and defects in accessories, insulated translucent sandwich panels and other components of the work.

B. Extended Panel Warranty: 5 years from date of delivery.

C. Extended Manufacturer's factory applied Finish Warranty: 10 years from date of delivery.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. The basis for this specification is for products manufactured by Structures Unlimited, Inc. Other manufacturers may bid this project subject to compliance with the performance requirements of this specification and submission evidence thereof. Listing other manufacturers' names in this specification does not constitute approval of their products or relieve them of compliance with all the performance requirements contained herein.

B. Structures Unlimited, Inc., Tel: (800) 225-3895 – Fax: (603) 627-0798 – Email: info@structuresunlimitedinc.com

2.2 PANEL COMPONENTS

A. Face Sheets:

1. Translucent faces: Manufactured from glass fiber reinforced thermoset resins, formulated specifically for architectural use.
   a. Thermoplastic (e.g. polycarbonate, acrylic) faces are not acceptable.
   b. Face sheets shall not deform, deflect, or drip when subjected to fire or flame.
2. Interior face sheets:
   a. Flame spread: Underwriters Laboratories (UL) listed, which requires periodic unannounced retesting, with flame spread rating no greater than 10 and smoke developed no greater than 350-400 when tested in accordance with UL 723.
   b. Burn extent by ASTM D 635 shall be no greater than 1".
3. Exterior face sheets:
   a. Color stability: Full thickness of the exterior face sheet shall not change color more than 3 CIE Units DELTA E by ASTM D 2244 after 3 years outdoor South Florida weathering at 5° facing south, as measured on a white sample with and without a protective film or coating to ensure long-term color stability. Color stability shall be unaffected by abrasion or scratching.
   b. Strength: Exterior face sheet shall be uniform in strength, impenetrable by handheld pencil and repel an impact minimum of 70 ft. lbs. without fracture or tear when impacted by a 3-1/4" diameter, 5 lb. free-falling ball per UL 972.
   c. Erosion Protection: Integral, embedded-glass erosion barrier.
4. Appearance:
   a. Exterior face sheet: Smooth, .070" thick and crystal in color.
   b. Interior face sheet: Smooth, .045" thick and white in color.
   c. Face sheets shall not vary more than ± 10% in thickness and be uniform in color.

B. Grid Core:

1. Aluminum I-beam grid core shall be of alloy and temper recommended by manufacturer with provisions for mechanical interlocking of muntin-mullion and perimeter. Width of I-beam shall be no less than 7/16".

C. Laminate Adhesive:

1. Heat and pressure resin type adhesive engineered for structural sandwich panel use, with minimum 25-years field use. Adhesive shall pass testing requirements specified by the International Code Council "Acceptance Criteria for Sandwich Panel Adhesives".
2. Minimum tensile strength of 750 PSI when the panel assembly is tested by ASTM C 297 after two exposures to six cycles each of the aging conditions prescribed by ASTM D 1037.
3. Minimum shear strength of the panel adhesive by ASTM D 1002 after exposure to four separate conditions:
   a. 50% Relative Humidity at 68° F: 540 PSI
   b. 182° F: 100 PSI
   c. Accelerated Aging by ASTM D 1037 at room temperature: 800 PSI
   d. Accelerated Aging by ASTM D 1037 at 182° F: 250 PSI

2.3 PANEL CONSTRUCTION

A. Provide sandwich panels of flat fiberglass reinforced translucent face sheets laminated to a grid core of mechanically interlocking I-beams. The adhesive bonding line shall be straight, cover the entire width of the I-beam and have a neat, sharp edge.

1. Thickness: 2-3/4”
2. Light transmission: 37%
3. Solar heat gain coefficient: 0.44
4. Panel U-factor by NFRC certified laboratory: 0.53
5. Grid pattern: Nominal size 12” x 24”; pattern shoji

B. Standard panels shall deflect no more than 1.9” at 30 PSF in 10’-0” span without a supporting frame by ASTM E 72.

C. Panels shall meet the conditions of acceptance according to ASTM E2707 Fire Penetration of Exterior Wall Assemblies Using a Direct Flame Impingement Exposure:

1. Absence of flame penetration through the wall assembly at any time.
2. Absence of evidence of glowing combustion on the interior surface of the assembly at the end of the 60-min observation period.
3. Absence of evidence of flame, glow, and smoke if the test is terminated prior to the completion of the 60-min observation period.

D. Canopy System:

1. Roof system shall pass Class A Roof Burning Brand Test by UL 790.

E. Canopy System shall meet the fall through requirements of OSHA 1910.21 as demonstrated by testing in accordance with ASTM E 661, thereby not requiring supplemental screens or railings.

2.4 BATTENS AND PERIMETER CLOSURE SYSTEM

A. Closure system: Extruded aluminum 6063-T6 and 6063-T5 alloy and temper clamp-tite screw type closure system.

B. Sealing tape: Manufacturer’s standard, pre-applied to closure system at the factory under controlled conditions.

C. Fasteners: Various series stainless steel screws for aluminum closures, excluding final fasteners to the building.

D. Finish: Manufacturer's factory applied finish, which meets the performance requirements of AAMA 2604. Color to be selected from manufacturer's standards.

2.5 SUPERSTRUCTURE

A. The superstructure shall be pre-fabricated of extruded aluminum alloy 6005-T5, 6005A-T61 or 6061-T6 box beams. Ferrous metals shall not be allowed. All parts shall be pre-

assembled at the factory and knocked down for shipment. System shall be a rigid frame design.

B. Finish: Manufacturer's factory applied finish, which meets the performance requirements of AAMA 2604. Color to be selected from manufacturer's standards.

C. Aluminum structural system design and calculations must be furnished in accordance with the Aluminum Association "Specifications for Aluminum Structures" and the applicable building code. Design calculations must be prepared and stamped by a Licensed Professional Engineer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Installer shall examine substrates, supporting structure and installation conditions.

B. Do not proceed with structural canopy installation until unsatisfactory conditions have been corrected by the general contractor.

3.2 PREPARATION

A. Metal Protection:

1. The general contractor shall prepare foundations, piers, curbs, footings and/or lintels isolating dissimilar materials from aluminum system, which may cause electrolysis.
2. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
3. Where aluminum will contact concrete, masonry or pressure treated wood, protect against corrosion by painting contact surfaces with bituminous paint or method recommended by manufacturer.

B. The general contractor shall install foundations, piers, curbs, footings and/or lintels designed to withstand the thrust generated by the canopy.

C. The general contractor shall provide temporary enclosures if required.

3.3 INSTALLATION

A. Install the canopy system in accordance with the manufacturer's installation recommendations and approved shop drawings.

B. After other trades have completed work on adjacent material, carefully inspect translucent panel installation and make adjustments necessary to ensure proper installation.

3.4 CLEANING

A. Refer to manufacturer's written recommendations.

END OF SECTION 107300

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SECTION 107516 - GROUND-SET FLAGPOLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes ground-set flagpoles made from aluminum.

B. Owner-Furnished Material: Flags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, operating characteristics, fittings, accessories, and finishes for flagpoles.

B. Shop Drawings: For flagpoles.

1. Include plans, elevations, and attachment details. Show general arrangement, jointing, fittings, accessories, grounding, anchoring, and support.
2. Include section, and details of foundation system.

C. Samples for Verification: For each type of exposed finish, in manufacturer's standard sizes.

D. Delegated-Design Submittal: For flagpoles.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flagpoles to include in operation and maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Spiral wrap flagpoles with heavy paper and enclose in a hard fiber tube or other protective container.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain flagpoles as complete units, including fittings, accessories, bases, and anchorage devices, from single source from single manufacturer.

2.2 ALUMINUM FLAGPOLES

A. Aluminum Flagpoles: Cone tapered flagpoles fabricated from seamless extruded tubing complying with ASTM B 241/B 241M, Alloy 6063, with a minimum wall thickness of 3/16 inch (4.8 mm).

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Acme/Lingo Flagpoles, LLC.
b. American Flagpole.
c. Baartol Company.
d. Concord Industries, Inc.
e. Eder Flag Manufacturing Company, Inc.
f. Ewing Flagpoles.
g. Morgan-Francis Flagpoles and Accessories.
h. Pole-Tech Company Inc.

B. Exposed Height: (1) 25 feet

C. Construct flagpoles in one piece if possible. If more than one piece is necessary, comply with the following:

1. Fabricate shop and field joints without using fasteners, screw collars, or lead calking.
2. Provide flush hairline joints using self-aligning, snug-fitting, internal sleeves.

D. Metal Foundation Tube: Manufacturer's standard corrugated-steel foundation tube, 0.060-inch (1.52-mm) wall thickness with 3/16-inch (4.8-mm) steel bottom plate and support plate; 3/4-inch- (19-mm-) diameter, steel ground spike; and steel centering wedges welded together. Galvanize foundation tube after assembly. Furnish loose hardwood wedges at top of foundation tube for plumbing pole.

1. Flashing Collar: Same material and finish as flagpole.

2.3 FITTINGS

A. Finial Ball: Flush-seam ball, sized as indicated or, if not indicated, to match flagpole-butt diameter.

1. 0.063-inch (1.6-mm) spun aluminum, finished to match flagpole.
2. 20-oz. (0.70-mm) copper with 23-karat, gold-leaf finish.

3. Spun stainless steel, finished to match flagpole.
4. Spun copper alloy, finished to match flagpole.

B. External Halyard: Ball-bearing, nonfouling, revolving truck assembly of cast metal with continuous 5/16-inch- (8-mm-) diameter, braided polypropylene halyard and 9-inch (228-mm) cast-metal cleats with fasteners. Finish exposed metal surfaces to match flagpole.

1. Halyards and Cleats: Two at each flagpole.
2. Cleat Covers: Cast metal, finished to match flagpole, secured with cylinder locks.
3. Halyard Covers: 2-inch (50-mm) channel, 60 inches (1500 mm) long, finished to match flagpole.
4. Halyard Flag Snaps: Stainless-steel swivel snap hooks with neoprene or vinyl covers. Furnish two per halyard.

2.4 MISCELLANEOUS MATERIALS

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M.

B. Drainage Material: Crushed stone, or crushed or uncrushed gravel; coarse aggregate.

C. Sand: ASTM C 33/C 33M, fine aggregate.

D. Elastomeric Joint Sealant: Single-component nonsag urethane joint sealant complying with requirements in Section 079200 "Joint Sealants."

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

2.5 ALUMINUM FINISHES

A. Natural Satin Finish: AA-M32, fine, directional, medium satin polish; buff complying with AA-M20; seal aluminum surfaces with clear, hard-coat wax.

B. Clear Anodized Finish

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare uncoated metal flagpoles that are set in foundation tubes by painting below-grade portions with a heavy coat of bituminous paint.

B. Foundation Excavation: Excavate to neat clean lines in undisturbed soil. Remove loose soil and foreign matter from excavation and moisten earth before placing concrete. Place and compact drainage material at excavation bottom.

C. Provide forms where required due to unstable soil conditions and for perimeter of flagpole base at grade. Secure and brace forms to prevent displacement during concreting.

D. Foundation Tube: Place foundation tube, center, and brace to prevent displacement during concreting. Place concrete. Plumb and level foundation tube and allow concrete to cure.

E. Place concrete. Compact concrete in place by using vibrators. Moist-cure exposed concrete for no fewer than seven days or use nonstaining curing compound.

F. Trowel exposed concrete surfaces to a smooth, dense finish, free of trowel marks, and uniform in texture and appearance. Provide positive slope for water runoff to perimeter of concrete base.

3.2 FLAGPOLE INSTALLATION

A. General: Install flagpoles where indicated and according to manufacturer's written instructions.

B. Foundation Tube: Place flagpole in tube, seated on bottom plate between steel centering wedges, and install hardwood wedges to secure flagpole in place. Place and compact sand in foundation tube and remove hardwood wedges. Seal top of foundation tube with a 2-inch (50-mm) layer of elastomeric joint sealant and cover with flashing collar.

END OF SECTION 107516

SECTION 122413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manually operated, single-roller shades.
2. Motor-operated, single-roller shades.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.
2. Section 079200 "Joint Sealants" for sealing the perimeters of installation accessories for light-blocking shades with a sealant.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

1. Motor-Operated Shades: Include details of installation and diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified, 10 inches (250 mm) long.

D. Samples for Verification: For each type of roller shade.

1. Shadeband Material: Not less than 10 inches (250 mm) square. Mark interior face of material if applicable.
2. Roller Shade: Full-size operating unit, not less than 16 inches (400 mm) wide by 36 inches (900 mm) long for each type of roller shade indicated.
3. Installation Accessories: Full-size unit, not less than 10 inches (250 mm) long.

E. Product Schedule: For roller shades.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of shadeband material.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Roller Shades: Full-size units equal to 5 percent of quantity installed for each size, color, and shadeband material indicated, but no fewer than two units.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED, SINGLE-ROLLER SHADES

A. Basis of Design: Inpro Corporation, H100 Solomount Manual Roller Shade, Roller Shade Color: As selected by Architect from manufacturer's full range.

B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

1. Bead Chains: Nickel-plated metal or Stainless steel.

a. Loop Length: Full length of roller shade.
b. Limit Stops: Provide upper and lower ball stops.
c. Chain-Retainer Type: Clip, jamb mount.

2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller shade weight and for lifting heavy roller shades.

a. Provide for shadebands that weigh more than 10 lb (4.5 kg) or for shades as recommended by manufacturer, whichever criterion is more stringent.

C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Roller Drive-End Location: Right side of interior face of shade.
2. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
3. Shadeband-to-Roller Attachment: Manufacturer's standard method.

D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

E. Shadebands:

1. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

a. Type: Enclosed in sealed pocket of shadeband material.
b. Color and Finish: As selected by Architect from manufacturer's full range.

F. Installation Accessories:

1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.

a. Shape: Curved.
b. Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 3 inches (76 mm).

2.3 MOTOR-OPERATED, SINGLE-ROLLER SHADES

A. Basis of Design: Inpro Corporation, Juniper Solarity Motorized Roller Shade, Roller Shade Color: As selected by Architect from manufacturer's full range.

B. Motorized Operating System: Provide factory-assembled, shade-operator system of size and capacity and with features, characteristics, and accessories suitable for conditions indicated, complete with electric motor and factory-prewired motor controls, power disconnect switch, enclosures protecting controls and operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.

1. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Electric Motor: Manufacturer's standard tubular, enclosed in roller.

    a. Maximum Total Shade Width: As required to operate roller shades indicated.
    b. Maximum Shade Drop: As required to operate roller shades indicated.
    c. Maximum Weight Capacity: As required to operate roller shades indicated.

3. Remote Control: Electric controls with NEMA ICS 6, Type 1 enclosure for recessed or flush mounting. Provide the following for remote-control activation of shades:

    a. Group Control Station: Momentary-contact, three-position, rocker-style, wall-switch-operated control station with open, close, and center off functions for single-switch group control.
    b. Color: As selected by Architect from manufacturer's full range.

4. Limit Switches: Adjustable switches interlocked with motor controls and set to stop shades automatically at fully raised and fully lowered positions.
5. Operating Features:

    a. Group switching with integrated switch control; single faceplate for multiple switch cutouts.

C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
2. Shadeband-to-Roller Attachment: Manufacturer's standard method.

D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

E. Installation Accessories:

1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.

a. Shape: Curved.
b. Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 3 inches (76 mm).

2.4 ROLLER SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch (6 mm) per side or 1/2-inch (13-mm) total, plus or minus 1/8 inch (3.1 mm). Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch (6 mm), plus or minus 1/8 inch (3.1 mm).

C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:

1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
2. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, locations of connections to building electrical system, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

1. Opaque Shadebands: Located so shadeband is not closer than 2 inches (51 mm) to interior face of glass. Allow clearances for window operation hardware.

B. Electrical Connections: Connect motor-operated roller shades to building electrical system.

C. Roller Shade Locations: As indicated on Drawings.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 122413

SECTION 123553 – STEEL LABORATORY CASEWORK AND RELATED PRODUCTS

PART 1 - DESCRIPTION OF WORK

1.1 SUMMARY AND SCOPE

A. Section Includes:

1. Using **Kewaunee Scientific Corporation, RESEARCH COLLECTION Laboratory Furniture** as a steel casework specification standard, furnish all cabinets and casework, including tops, ledges, supporting structures, and miscellaneous items of equipment as listed in these specifications, equipment schedules, and drawings. Include delivery to the building, set in place, level, and scribe to walls and floors as required. Furnish and install all filler panels, knee space panels and scribes as shown on drawings.

2. Furnish and deliver all utility service outlet accessory fittings, electrical receptacles and switches as listed in these specifications, equipment schedules, and drawings, as mounted on the laboratory furniture. All plumbing and electrical fittings, not preinstalled in equipment, shall be packaged separately and properly marked for delivery to the appropriate contractor.

3. Furnish and deliver, for installation by the mechanical contractor, all laboratory sinks, cup sinks or drains, drain troughs, overflows and sink outlets with integral tailpieces, which occur above the floor, and where these items are part of the equipment or listed in these specifications, equipment schedules, and drawings. All tailpieces shall be furnished less the couplings required to connect them to the drain piping system.

4. Furnish service strip supports where specified, and set in place, service tunnels, service turrets, supporting structures and reagent racks of the type shown on the drawings.

5. Remove of all debris, dirt and rubbish accumulated as a result of the installation of the laboratory furniture to an onsite container provided by others, leaving the premises broom clean and orderly.

B. Related Divisions:

1. Divisions 5 & 6: Behind-the-Wall Blocking and Studs

2. Division 9: Base Molding

3. Division 22: Plumbing

4. Division 26: Electrical Fittings and Connections

5. Division 27: Communications

C. Related Publications:

1. SEFA 3 - Scientific Equipment and Furniture Association
2. SEFA 8 - Scientific Equipment and Furniture Association
3. NFPA 30 - National Fire Protection Association
4. NFPA-45 - National Fire Protection Association
5. UL - Underwriters Laboratories
6. ASTM D522 - Bending Test

1.2 BASIS OF WORK

A. It is the intent of this specification to use Kewaunee Scientific Corporation – RESEARCH COLLECTION Laboratory Furniture as the standard of construction for laboratory furniture. The construction standards of this product line shall provide the basis for quality and functional installation.

B. Supply all equipment in accordance with this specification. The offering of a product differing in materials and construction from this specification requires written approval from the owner/architect. This approval must be obtained seven (7) days before the quotation deadline. Procedures for obtaining approval for an alternate manufacturer are defined in section 1.03.B in this specification.

C. General Contractors should secure a list of approved laboratory furniture manufacturers from the architect as a protection against non-conformance to these specifications.

D. Participants in the quotation process have the option of clarifying deviations to the specified design, construction, or materials. Without such clarifications, sealed quotations to the owner or owner representative will be construed as being in total conformance to the requirements of the specification.

E. The owner/owner's representative reserves the right to reject qualified or alternate proposals and to award based on product value where such action assures the owner greater integrity of product.

1.3 QUALITY ASSURANCE

A. The steel laboratory furniture contractor shall also provide worktops and fume hoods all manufactured or shipped from the same geographic location to assure proper staging, shipment and single source responsibility.

B. General Performance: Provide certification that furniture shall meet the performance requirements described in SEFA 8.

C. Finish Performance: Provide independent test lab certification that furniture shall meet the performance requirements described in section 2.05 of these specifications.

1.4 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's data and installation instructions for each type of casework.

B. Samples: Samples from non-specified manufacturers will be required and reviewed per specification. Samples shall be delivered, at no cost to the architect or owner, to a destination set forth by the architect or owner. This must be done seven (7) days before quotation deadline as a condition of approval of each bidder. Samples shall be full size, production type samples. Miniature or "Show Room" type samples are not acceptable. Furnish the following:

1. One 18" combination (1) drawer and (1) cupboard base unit showing complete construction details, including (1) shelf

2. One sample of all top materials shown or called for, of sufficient size to perform finish requirement tests

3. Sample of all mechanical service fittings, locks, door pulls, hinges, and interior hardware. The architect or owner will retain the above samples of the successful manufacture to insure that material delivered to jobsite conforms in every respect to the samples submitted.

C. Shop Drawings: Submit shop drawings for furniture assemblies showing plans, elevations, ends, cross-sections, service run spaces, location and type of service fittings.

1. Coordinate shop drawings with other work involved.

2. Provide roughing-in drawings for mechanical and electrical services when required.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The basis of this specification is steel casework manufactured according to the standards used by **Kewaunee Scientific Corporation**, 2700 Front Street, Statesville, North Carolina. The specified design is Research Collection. All laboratory equipment covered by the specification shall be the product of one manufacturer and be fabricated at one geographic location to assure shipping continuity and single-source responsibility. All quotations from a manufacturer other than Kewaunee Scientific Corporation shall contain a review of the following capabilities:

1. List of shop facilities

2. List of engineering and manufacturing personnel

3. Proof of financial ability to fulfill the contract

4. List of a minimum of ten (10) installations over the last five (5) years of comparable scope

5. Proof of project management and installation capabilities

6. SEFA member in Good Standing

B. The selected manufacturer shall warrant that all products be free of defects in material and workmanship for a period of one year. The period shall start at the date of acceptance or occupation, whichever comes first. Purchaser shall notify the manufacturer's representative immediately of any defective product. The manufacturer shall have a reasonable opportunity to inspect the goods. The purchaser shall return no product until receipt by purchaser of written shipping instructions from the manufacturer.

2.2 CABINET MATERIAL:

A. Steel: Cabinet bodies, drawer bodies, shelves, drawer heads and door assemblies shall be fabricated from cold rolled steel.

2.3 DRAWER AND DOOR STYLE:

A. Overlay – Square Edge: Drawer and door, when closed, shall rest against face of cabinet shell, creating a 3/4" overlay front with 1/8" reveal. The outer drawer and door head shall have a channel formation on all four sides to eliminate sharp raw edges of steel. The top front corners of the door shall be welded and ground smooth. Cabinet shall be available with 5-knuckle, semi-concealed or concealed hinges and optional pulls.

2.4 MATERIALS

A. General Requirements: It is the intent of this specification to provide a high quality steel cabinet specifically designed for the laboratory environment.

B. Steel:

1. Cold Rolled Steel: Cold rolled sheet steel shall be prime grade 12, 14, 16, 18 and 20 gauge U.S. Standard; roller leveled, and shall be treated at the mill to be free of scale, ragged edges, deep scratches or other injurious effects.

2. Stainless Steel: Stainless Steel shall be Type 304; 12, 14, 16, 18 and 20 gauge U.S. Standard. Stainless steel shall be supplied with a #4 finish free of burrs, weld marks, or other imperfections.

C. Composition Core Plywood: Composition core plywood shall be 3-ply and shall be compliant with ANSI A208.1-199, and/or ANSI A208.2-1994

D. Hardware and Trim:

1. Drawer and Door Pulls:

a. Drawer and door pulls shall be mounted on 4" centers, offering a comfortable hand grip, and be securely fastened to doors and drawers.
b. They shall be manufactured from: Pull Style 9 – Anodized aluminum.

2. Hinges:

   a. Overlay Hinges: Overlay style cabinets shall use:
      1) Overlay 5-Knuckle Hinges: 5-Knuckle hinges made of Type 304 stainless steel .089 thick, 2-1/2" high, with brushed satin finish, and shall be the institutional type with a five-knuckle bullet-type barrel. Hinges shall be attached to both door and case with two screws through each leaf. Welding of hinges to door or case will not be accepted. Doors under 36" in height shall be hung on one pair of hinges, and doors over 36" in height shall be hung on three hinges.

3. Drawer Slide:

   a. Heavy duty, full extension, soft-close, self-closing, zinc plated, ball bearing slides, rated for 100 pound loads (See Drawer Assemblies in 2.04, option 1)

4. Catches – For steel casework with 5-knuckle hinges:

   a. Roller Catches: A spring-loaded catch with polyethylene roller shall be provided on cabinet doors and shall be positioned near the pull edge of door to provide maximum latching force. The roller shall engage a strike, integral to the cabinet top or division rail.

5. Shelf Adjustment Clips: Shelf adjustment clips shall be die formed, nickel-plated steel.

6. Leg Shoes: Leg shoes shall be a pliable, black vinyl material and shall be provided on all table legs, unless otherwise specified, to conceal leveling device. Use of a leg shoe, which does not conceal leveling device, will not be acceptable.

7. Base Molding: Base molding shall be provided by others.

8. Sink Supports: Sink supports shall be the hanger type, suspended from end panels of sink cabinet by four 1/4" dia. rods, threaded at bottom end and offset at top to hang from two full-depth reinforcements, welded to the top of end panels. Two 3/4" x 1-1/2" x 12 gauge channels shall be hung on the threaded rods to provide an adjustable sink cradle for supporting sinks.

9. Support Struts: Support struts shall consist of two 16 gauge channel uprights fastened top and bottom by two adjustable 12 gauge "U" shaped spreaders, each, 1-1/2" x length required, formed from galvanized steel. Struts shall be furnished to support drain troughs, and to support worktop at plumbing space under fume hood superstructures or other heavy loads. Support struts can be furnished with hangers at extra cost when specified, to support mechanical service piping and drain lines.

2.5 CONSTRUCTION

A. Steel Cabinet Construction:

1. General:

a. The steel furniture shall be of modern design and shall be constructed in accordance with the best practices of the Scientific Laboratory Equipment Industry. First class quality casework shall be insured by the use of proper machinery, tools, dies, fixtures and skilled workmanship to meet the intended quality and quantity for the project.
b. All cabinet bodies shall be flush front construction with intersection of vertical and horizontal case members, such as end panels, top rails, bottoms and vertical posts in same plane without overlap. Exterior corners shall be spot welded with heavy back up reinforcements.
c. Each cabinet shall be complete so that units can be relocated at any subsequent time without requiring field application of finished ends or other such parts.
d. Case openings of Inset style cabinets shall be rabbeted on all four sides for both hinged and sliding doors to provide a dust resistant case.
e. All cabinets shall have a cleanable smooth interior. Bottoms shall be formed down on sides and back to create easily cleanable corners with no burrs or sharp edges.
f. Cabinets shall be designed using a standardized grid pattern to allow reconfiguration of doors and drawers.

2. Steel Gauges: Gauges of steel used in construction of cases shall be 18 gauge, except as follows:

a. Leveling bolt reinforcements 12 gauge.
b. Top and intermediate front horizontal rails, apron rails, hinge reinforcements, and reinforcement gussets, 16 gauge.
c. Drawer assemblies, door assemblies, bottom, bottom back rail, toe space rail, and adjustable shelves, 20 gauge.

B. Base Cabinets:

1. End uprights shall be formed into not less than an L formation at top, bottom, back and a 3/4" wide front C formation. A pilaster shall be added to the inside front of the upright for cabinet and hinge reinforcement and shall be perforated for the support of drawer channels, intermediate rails, hinge screws, and shelf adjustment holes.

2. A 7/8" high top horizontal rail shall interlock with the flange at top of end panels for strength, but shall be flush at face of unit. Top rails not flush with face of end uprights are not acceptable.

3. Intermediate rails shall be provided between doors and drawers, but shall not be provided between drawers unless made necessary by locks in drawers. Intermediate rails shall be recessed behind doors and drawer fronts, and designed so that security panels may be added as required.

4. Intermediate vertical uprights shall be furnished to enclose cupboards when used in a unit in combination with a half width bank of drawers.

5. Cabinet bottom shall be formed of one piece of steel, except in corner units, and shall be formed down on sides and back to create a square edge transition welded to cabinet end panels. Front edge shall include a C formation to form a 7/8" high bottom front rail and shall be flush with face of end uprights. Cabinet bottom front rails not flush with face of end uprights are not acceptable.

6. Toe space rail shall extend up and forward to engage bottom panel to form a smooth surfaced fully enclosed toe space, 3" deep x 4" high.

7. Back construction shall be one piece with integral channel formed for maximum strength and welded to back of top and bottom flanges of end uprights.

8. Each bottom corner of base cabinets shall have a 3/8"-16 leveling bolt, 2-1/2" long capable of supporting 500 lbs. Access to the leveling bolts shall be through plug buttons in the cabinet bottom. Access to leveling bolts through toe space or leveling bolts requiring special tools to adjust are not acceptable.

9. Adjustable shelves shall be formed down 3/4", returned back 7/8" and up 1/4" into a channel formation front and rear and formed down 3/4" at each end. Shelves over 42" long shall be further reinforced with a channel formation welded to underside of shelf. Shelves shall be adjustable on not more than 1" increments.

10. Steel Door assembly (two-piece) for solid panel swinging doors shall consist of an inner and outer door pan. Outer door pan shall be formed at all four sides. The corners on the pull side of the outer door pan shall be welded and ground smooth to prevent exposure of sharp edges of steel at these critical points. Inner door pan shall be flanged at all four sides with hinge reinforcements welded in place. The door assembly shall be 3/4" thick and contains sound deadening material. Door assemblies shall be painted prior to assembly, and shall be punched for attaching pulls. Inner pan formation of door shall be indented for in-field installation of locks when required.

11. Doors shall be readily removable and hinges easily replaceable. Hinges shall be applied to the cabinet and door with screws. Welding of hinges to either cabinet or door will not be acceptable.

12. Drawer Assemblies:

    a. Drawer bodies shall be made in one-piece construction including the bottom, two sides, back and front. They shall be fully coved at interior bottom on all four sides for easy cleaning. The top front of the inner drawer body shall be offset to interlock with the channel formation in drawer head providing a 3/4" thick drawer head.

13. Knee space panels, where shown or specified, shall be 20 gauge, finished same as casework cabinets, and easily removable for access to mechanical service areas.

C. Upper Cabinet Construction:

1. Upper cabinets shall have a completely finished interior same as exterior and shall be designed so that no mounting hardware is visible when installed.

2. End uprights shall be formed at front, bottom and back to provide maximum strength and rigidity. Front edge of end upright shall be 3/4” wide. A pilaster shall be added to the inside front of the upright for cabinet and hinge reinforcement and shall be perforated for hinge screws, and shelf adjustment holes.

3. Cabinet tops shall be formed with a 7/8" high C formation at the front edge and turned down at the back to engage a wall hanging rail.

4. Cabinet flush bottoms shall be formed with a 7/8" high C formation at the front edge.

5. Cabinet false bottoms shall be formed down on all four edges and shall be removable.

6. Cabinet backs shall be welded to the top, bottom and ends. Backs shall be perforated for shelf adjustment holes. Holes shall be enclosed by end uprights.

7. Adjustable shelves shall be formed down 3/4", returned back 7/8" and up 1/4" into a channel formation front and rear, formed down 3/4" at each end. Shelves over 42" long shall be further reinforced with a channel formation welded to underside of shelf. Shelves shall be adjustable on not more than 1" increments.

8. Solid panel doors shall consist of an inner and outer door pan. Outer door pan shall be formed into a channel or flanged shape at all four sides. The corners on the pull side of the outer door pan shall be welded and ground smooth to prevent exposure of sharp edges of steel at these critical points. Inner door pan shall be flanged at all four sides with hinge reinforcements welded in place. The door assembly shall be 3/4" thick and contains sound deadening material.

9. Swinging doors under 36" high shall be hung on one pair of hinges, doors over 36" high shall be hung on three hinges.

2.6 PERFORMANCE REQUIREMENTS

A. Steel Casework Construction Performance:

1. Base cabinets shall be constructed to support at least a uniformly distributed load 200 pounds per square foot of cabinet top area, including working surface without objectionable distortion of interference with door and drawer operation.

2. Base cabinet leveling bolts shall support 500 pounds per corner, at 1-1/2" projection of the leveling bolt below the cabinet bottom.

3. Each adjustable and fixed shelf 4 feet or shorter in length shall support an evenly distributed load of 40 pounds per square foot up to a maximum of 200 pounds, with nominal temporary deflection, but without permanent set.

4. Full extension soft-close, self-closing ball bearing zinc plated drawer slide shall be rated for 100 pound loads.

5. Swinging doors on floor-mounted inset style casework shall support 200 pounds suspended at a point 12" from hinged side, with door swung through an arc of 160 degrees. Weight load test shall allow only a temporary deflection, without permanent distortion or twist. Door shall operate freely after test and assume a flat plane in a closed position.

B. Steel Paint System Finish and Performance Specification:

1. Steel Paint System Finish:

    a. After Cold Rolled Steel and Textured Steel component parts have been completely welded together and before finishing, they shall be given a pre-paint treatment to provide excellent adhesion of the finish system to the steel and to aid in the prevention of corrosion. Physical and chemical cleaning of the steel shall be accomplished by washing with an alkaline cleaner, followed by a spray treatment with a complex metallic phosphate solution to provide a uniform fine grained crystalline phosphate surface that shall provide both an excellent bond for the finish and enhance the protection provided by the finish against humidity and corrosive chemicals.
    b. After the phosphate treatment, the steel shall be dried and all steel surfaces shall be coated with a chemical and corrosion-resistant, environmentally friendly, electrostatically applied powder coat finish. All components shall be individually painted, ensuring that no area be vulnerable to corrosion due to lack of paint coverage. The coating shall then be cured by baking at elevated temperatures to provide maximum properties of corrosion and wear resistance.
    c. The completed finish system in standard colors shall meet the performance test requirements specified under PERFORMANCE TEST RESULTS.
    d. Paint color to be selected by Architect from manufacturer's full range.
        1) Color to have a matte finish.

2. Performance Test Results (Chemical Spot Tests):

    a. Testing Procedure: Chemical spot tests for non-volatile chemicals shall be made by applying 5 drops of each reagent to the surface to be tested and covering with a 1-1/4" dia. watch glass, convex side down to confine the reagent. Spot tests of volatile chemicals shall be tested by placing a cotton ball saturated with reagent on the surface to be tested and covering with an inverted 2-ounce wide mouth bottle to retard evaporation. All spot tests shall be conducted in such a manner that the test surface is kept wet throughout the entire test period, and at a temperature of 77° ±3° F. For both methods, leave the reagents on the panel for a period of one hour. At the end of the test period, the reagents shall be flushed from the surface with water, and the surface scrubbed with a soft bristle brush under running water, rinsed and dried. Volatile solvent test areas shall be cleaned with a cotton swab soaked in the solvent used on the test area. Immediately prior to evaluation, 16 to 24 hours after the reagents are removed, the test surface shall be scrubbed with a damp paper towel and dried with paper towels.
    b. Test Evaluation: Evaluation shall be based on the following rating system.
        1) Level 0 – No detectable change.
        2) Level 1 – Slight change in color or gloss.
        3) Level 2 – Slight surface etching or severe staining.
        4) Level 3 – Pitting, cratering, swelling, or erosion of coating. Obvious and significant deterioration.
        5) After testing, panel shall show no more than three (3) Level 3 conditions.
    c. Test Reagents

Test No.	Chemical Reagent	Test Method
1.	Acetate, Amyl	Cotton ball & bottle
2.	Acetate, Ethyl	Cotton ball & bottle
3.	Acetic Acid, 98%	Watch glass
4.	Acetone	Cotton ball & bottle

5.	Acid Dichromate, 5%	Watch glass
6.	Alcohol, Butyl	Cotton ball & bottle
7.	Alcohol, Ethyl	Cotton ball & bottle
8.	Alcohol, Methyl	Cotton ball & bottle
9.	Ammonium Hydroxide, 28%	Watch glass
10.	Benzene	Cotton ball & bottle
11.	Carbon Tetrachloride	Cotton ball & bottle
12.	Chloroform	Cotton ball & bottle
13.	Chromic Acid, 60%	Watch glass
14.	Cresol	Cotton ball & bottle
15.	Dichlor Acetic Acid	Cotton ball & bottle
16.	Dimethylformanide	Cotton ball & bottle
17.	Dioxane	Cotton ball & bottle
18.	Ethyl Ether	Cotton ball & bottle
19.	Formaldehyde, 37%	Cotton ball & bottle
20.	Formic Acid, 90%	Watch glass
21.	Furfural	Cotton ball & bottle
22.	Gasoline	Cotton ball & bottle
23.	Hydrochloric Acid, 37%	Watch glass
24.	Hydrofluoric Acid, 48%	Watch glass
25.	Hydrogen Peroxide, 3%	Watch glass
26.	Iodine, Tincture of	Watch glass
27.	Methyl Ethyl Ketone	Cotton ball & bottle
28.	Methylene Cloride	Cotton ball & bottle
29.	Mono Chlorobenzene	Cotton ball & bottle
30.	Naphthalene	Cotton ball & bottle
31.	Nitric Acid, 20%	Watch glass
32.	Nitric Acid, 30%	Watch glass
33.	Nitric Acid, 70%	Watch glass
34.	Phenol, 90%	Cotton ball & bottle
35.	Phosphoric Acid, 85%	Watch glass
36.	Silver Nitrate, Saturated	Watch glass
37.	Sodium Hydroxide, 10%	Watch glass
38.	Sodium Hydroxide, 20%	Watch glass
39.	Sodium Hydroxide, 40%	Watch glass
40.	Sodium Hydroxide, Flake	Watch glass
41.	Sodium Sulfide, Saturated	Watch glass
42.	Sulfuric Acid, 33%	Watch glass
43.	Sulfuric Acid, 77%	Watch glass
44.	Sulfuric Acid, 96%	Watch glass
45.	Sulfuric Acid, 77% and Nitric Acid, 70%, equal parts	Watch glass
46.	Toluene	Cotton ball & bottle
47.	Trichloroethylene	Cotton ball & bottle
48.	Xylene	Cotton ball & bottle
49.	Zinc Chloride, Saturated	Watch glass

* Where concentrations are indicated, percentages are by weight.

3. Performance Test Results (Heat Resistance): Hot water (190° F - 205° F) shall be allowed to trickle (with a steady stream at a rate not less than 6 ounces per minute) on the finished surface, which shall be set at an angle of 45° from horizontal, for a period of five minutes. After cooling and wiping dry, the finish shall show no visible effect from the hot water treatment.

4. Performance Test Results (Impact Resistance): A one-pound ball (approximately 2" diameter) shall be dropped from a distance of 12 inches onto the finished surface of steel panel supported underneath by a solid surface. There shall be no evidence of cracks or checks in the finish due to impact upon close eye-ball examination.

5. Performance Test Results (Bending Test): An 18 gauge steel strip, finished as specified, when bent 180o over a 1/2" diameter mandrel, shall show no peeling or flaking off of the finish.

6. Performance Test Results (Adhesion): Ninety or more squares of the test sample shall remain coated after the scratch adhesion test. Two sets of eleven parallel lines 1/16" apart shall be cut with a razor blade to intersect at right angle thus forming a grid of 100 squares. The cuts shall be made just deep enough to go through the coating, but not into the substrate. They shall then be brushed lightly with a soft brush. Examine under 100 foot-candles of illumination. Note: This test is based on ASTM D2197-68, "Standard Method of Test for Adhesion of Organic Coatings".

7. Performance Test Results (Hardness): The test sample shall have a hardness of 4-H using the pencil hardness test. Pencils, regardless of their brand are valued in this way: 8-H is the hardest, and next in order of diminishing hardness are 7-H, 6-H, 5-H, 4-H, 3-H, 2-H, F, HB, B (soft), 2-B, 3-B, 4-B, 5-B (which is the softest).

8. The pencils shall be sharpened on emery paper to a wide sharp edge. Pencils of increasing hardness shall be pushed across the paint film in a chisel-like manner until one is found that will cut or scratch the film. The pencil used before that one, that is, the hardest pencil that will not rupture the film, is then used to express or designate the hardness.

2.7 WORKSURFACES

1. Materials: Stainless Steel

    a. Stainless steel worksurfaces to have a marine edge.

2.8 SINKS

A. Sinks:

1. Stainless Steel Sink

    a. Integral with stainless steel worksurfaces

PART 3 - EXECUTION

3.1 SITE EXAMINATION

A. The owner and/or his representative shall assure all building conditions conducive to the installation of a finished goods product; all critical dimensions and conditions previously checked have been adhered to by other contractors (general, mechanical, electrical, etc.) to assure a quality installation.

3.2 INSTALLATION

A. Preparation: Prior to beginning installation of casework, check and verify that no irregularities exist that would affect quality of execution of work specified.

B. Coordination: Coordinate the work of the Section with the schedule and other requirements of other work being prepared in the area at the same time both with regard to mechanical and electrical connections to and in the fume hoods and the general construction work.

C. Performance:

1. Casework:

a. Set casework components plumb, square, and straight with no distortion and securely anchor to building structure. Shim as required using concealed shims.
b. Bolt continuous cabinets together with joints flush, tight and uniform, and with alignment of adjacent units within 1/16" tolerance.
c. Secure wall cabinets to solid supporting material, not to plaster, lath or gypsum board.
d. Abut top edge surfaces in one true plane. Provide flush joints not to exceed 1/8".

2. Worksurfaces:

a. Where required due to field conditions, scribe to abutting surfaces.
b. All joints in the worksurfaces are to be welded and polished smooth.
c. Secure worksurfaces to casework and equipment components with materials and procedures recommended by the manufacturer.

D. Adjust and Clean:

1. Repair or remove and replace defective work, as directed by owner and/or his representative upon completion of installation.

2. Adjust doors, drawers and other moving or operating parts to function smoothly.

3. Clean shop finished casework; touch up as required.

4. Clean worksurfaces and leave them free of all grease and streaks.

5. Casework to be left broom clean and orderly.

E. Protection:

1. Provide reasonable protective measures to prevent casework and equipment from being exposed to other construction activity.

2. Advise owner and/or his representative of procedures and precautions for protection of material, installed laboratory casework and fixtures from damage by work of other trades.

END OF SECTION

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SECTION 123661 - SIMULATED STONE COUNTERTOPS AND STOOLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Solid-surface-material window stools, countertops and backsplashes.

1.3 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

C. Samples for Initial Selection: For each type of material exposed to view.

D. Samples for Verification: For the following products:
   1. One full-size solid-surface-material countertop, with front edge and backsplash, 8 by 10 inches (200 by 250 mm), of construction and in configuration specified.

1.4 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.5 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 SOLID-SURFACE-MATERIAL COUNTERTOPSWINDOW STOOLS

A. Configuration: Provide stools and countertops with the following front and backsplash style:

   1. Front: Straight, slightly eased at top.

2. Backsplash: Straight, slightly eased at corner.

B. Countertops: 3/4-inch- (19-mm-) thick, solid surface material with front edge built up with same material.

C. Stools: 1/2-inch- (12.7-mm-) thick, solid surface material.

D. Fabrication: Fabricate tops in one piece with shop-applied edges unless otherwise indicated. Comply with solid-surface-material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

1. Fabricate with loose backsplashes for field assembly.

2.2 COUNTERTOP MATERIALS

A. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

B. Solid Surface Material: Homogeneous solid sheets of filled plastic resin complying with ANSI SS1.

C. Tile Type SS-1: Solid Surface
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings.

D. Tile Type SS-2: Solid Surface
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install countertops level to a tolerance of 1/8 inch in 8 feet (3 mm in 2.4 m).

B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

1. Install backsplashes and endsplashes to comply with manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
2. Seal edges of cutouts in particleboard subtops by saturating with varnish.

END OF SECTION 123661

SECTION 133419 - METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Structural-steel framing.
2. Metal roof panels.
3. Metal wall panels.
4. Thermal insulation.
5. Accessories.

B. Related Requirements:

1. Section 077253 "Snow Retention Bars" for prefabricated devices designed to hold snow on the roof surface.
2. Section 083613 "Sectional Doors" for sectional vehicular doors in metal building systems.

1.3 DEFINITIONS

A. Terminology Standard: See MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in standards referenced by this Section.

1.4 COORDINATION

A. Coordinate sizes and locations of concrete foundations and casting of anchor-rod inserts into foundation walls and footings. Anchor rod installation, concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."

B. Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to metal building systems including, but not limited to, the following:
   a. Condition of foundations and other preparatory work performed by other trades.
   b. Structural load limitations.
   c. Construction schedule. Verify availability of materials and erector's personnel, equipment, and facilities needed to make progress and avoid delays.
   d. Required tests, inspections, and certifications.
   e. Unfavorable weather and forecasted weather conditions and impact on construction schedule.

2. Review methods and procedures related to metal roof panel assemblies including, but not limited to, the following:
   a. Compliance with requirements for purlin and rafter conditions, including flatness and attachment to structural members.
   b. Structural limitations of purlins and rafters during and after roofing.
   c. Flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roof panels.
   d. Temporary protection requirements for metal roof panel assembly during and after installation.
   e. Roof observation and repair after metal roof panel installation.

3. Review methods and procedures related to metal wall panel assemblies including, but not limited to, the following:
   a. Compliance with requirements for support conditions, including alignment between and attachment to structural members.
   b. Structural limitations of girts and columns during and after wall panel installation.
   c. Flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
   d. Temporary protection requirements for metal wall panel assembly during and after installation.
   e. Wall observation and repair after metal wall panel installation.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of metal building system component.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
   a. Metal roof panels.
   b. Metal wall panels.
   c. Thermal insulation, vapor-retarder, and air barrier.

B. Shop Drawings: Indicate components by others. Include full building plan, elevations, sections, details and the following:

1. Anchor-Rod Plans: Submit anchor-rod plans and templates before foundation work begins. Include location, diameter, and minimum required projection of anchor rods required to attach metal building to foundation. Indicate column reactions at each location.
2. Structural-Framing Drawings: Show complete fabrication of primary and secondary framing; include provisions for openings. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.
   a. Show provisions for attaching roof curbs and pipe racks.

3. Metal Roof and Wall Panel Layout Drawings: Show layouts of panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, clip spacing, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work; show locations of exposed fasteners.
   a. Show roof-mounted items including roof hatches, equipment supports, pipe supports and penetrations, lighting fixtures, and items mounted on roof curbs.
   b. Show wall-mounted items including personnel doors, vehicular doors, windows, louvers, and lighting fixtures.

4. Accessory Drawings: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches (1:8):
   a. Flashing and trim.
   b. Gutters.
   c. Downspouts.

C. Samples for Verification: For the following products:

1. Panels: Nominal 12 inches long by actual panel width. Include fasteners, closures, and other exposed panel accessories.
2. Flashing and Trim: Nominal 12 inches long. Include fasteners and other exposed accessories.
3. Vapor-Retarder Facings: Nominal 6-inch square Samples.
4. Accessories: Nominal 12-inch long Samples for each type of accessory.

D. Delegated-Design Submittal: For metal building systems.

1. Include analysis data indicating compliance with performance requirements and design data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For erector.

B. Welding certificates.

C. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:

1. Name and location of Project.
2. Order number.
3. Name of manufacturer.
4. Name of Contractor.
5. Building dimensions including width, length, height, and roof slope.
6. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
7. Governing building code and year of edition.
8. Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure, seismic design category or effective peak velocity-related acceleration/peak acceleration, and auxiliary loads (cranes).
9. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.
10. Building-Use Category: Indicate category of building use and its effect on load importance factors.

D. Erector Certificates: For qualified erector, from manufacturer.

E. Material Test Reports: For each of the following products:

1. Structural steel including chemical and physical properties.
2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shop primers.
5. Nonshrink grout.

F. Source quality-control reports.

G. Field quality-control reports.

H. Surveys: Show final elevations and locations of major members. Indicate discrepancies between actual installation and the Contract Documents. Have surveyor who performed surveys certify their accuracy.

I. Sample Warranties: For special warranties.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panel finishes to include in maintenance manuals.

1.9 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer.

1. Accreditation: Manufacturer's facility accredited according to the International Accreditation Service's AC472, "Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems."
2. Engineering Responsibility: Preparation of comprehensive engineering analysis and Shop Drawings by a professional engineer who is legally qualified to practice in jurisdiction where Project is located.

B. Erector Qualifications: An experienced erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."

D. Land Surveyor Qualifications: A professional land surveyor who practices in jurisdiction where Project is located and who is experienced in providing surveying services of the kind indicated.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

1.11 FIELD CONDITIONS

A. Weather Limitations: Proceed with panel installation only when weather conditions permit metal panels to be installed according to manufacturers' written instructions and warranty requirements.

1.12 WARRANTY

A. Special Warranty on Metal Panel Finishes: Manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

B. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that leak or otherwise fail to remain weathertight within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. American Buildings Company; a Nucor Company.
2. Butler Manufacturing Company; a division of BlueScope Buildings North America, Inc.

2.2 SYSTEM DESCRIPTION

A. Provide a complete, integrated set of mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior.

B. Primary-Frame Type:

1. Rigid Clear Span: Solid-member, structural-framing system without interior columns.

C. End-Wall Framing: Engineer end walls to be non-expandable. Provide end-wall columns.

D. Secondary-Frame Type: Manufacturer's standard purlins and joists and flush-framed girts.

E. Eave Height: <24 feet.

F. Bay Spacing: As indicated on Drawings.

G. Roof Slope: 2 inch per 12 inches (2:12).

H. Roof System: Manufacturer's standard standing-seam, metal roof panels.

1. Liner Panels: Standing seam.

I. Exterior Wall System: Manufacturer's standard concealed-fastener, flush-seam, metal wall panels.

1. Liner Panels: Flush seam, concealed fastener.

2.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design metal building system.

B. Structural Performance: Metal building systems shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to procedures in MBMA's "Metal Building Systems Manual."

1. Design Loads: As indicated on Drawings.
2. Deflection and Drift Limits: Design metal building system assemblies to withstand serviceability design loads without exceeding deflections and drift limits recommended in AISC Steel Design Guide No. 3 "Serviceability Design Considerations for Steel Buildings."
3. Deflection and Drift Limits: No greater than the following:
    a. Purlins and Rafters: Vertical deflection of 1/240 of the span.
    b. Girts: Horizontal deflection of 1/240 of the span.
    c. Metal Roof Panels: Vertical deflection of 1/240 of the span.
    d. Metal Wall Panels: Horizontal deflection of 1/240 of the span.
    e. Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.
    f. Lateral Drift: Maximum of 1/180 of the building height.

C. Seismic Performance: Metal building system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

E. Fire Propagation Characteristics: Exterior wall assemblies containing foam plastics pass NFPA 285 fire test.

F. Structural Performance for Metal Roof and Wall Panels: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

1. Wind Loads: As indicated on Drawings.

G. Air Infiltration for Metal Roof Panels: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E1680 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft.

H. Air Infiltration for Metal Wall Panels: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft.

I. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E1646 or ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft.

J. Water Penetration for Metal Wall Panels: No water penetration when tested according to ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft.

K. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

1. Uplift Rating: UL 60.

L. FM Global Listing: Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.

1. Fire/Windstorm Classification: Class 1A- 90.
2. Hail Resistance: SH.

M. Energy Star Listing: Roof panels that are listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.

N. Energy Performance: Provide roof panels according to one of the following when tested according to CRRC-1:

1. Three-year, aged, solar reflectance of not less than 0.55 and emissivity of not less than 0.75.
2. Three-year, aged, Solar Reflectance Index of not less than 64 when calculated according to ASTM E1980.

O. Thermal Performance for Opaque Elements: Provide the following maximum U-factors and minimum R-values when tested according to ASTM C1363 or ASTM C518:

1. Roof:
   a. U-Factor: 0.031.
   b. R-Value: 11.0 + 25.0.

2. Walls:
   a. U-Factor: 0.044.
   b. R-Value: 32.5.

2.4 STRUCTURAL-STEEL FRAMING

A. Structural Steel: Comply with AISC 360, "Specification for Structural Steel Buildings."

B. Bolted Connections: Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts."

C. Cold-Formed Steel: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stresses.

D. Primary Framing: Manufacturer's standard primary-framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafters, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.

1. General: Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.
   a. Slight variations in span and spacing may be acceptable if necessary to comply with manufacturer's standard, as approved by Architect.
2. Rigid Clear-Span Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Interior columns are not permitted.
3. Frame Configuration: Single gable.
4. Exterior Column: Tapered.
5. Rafter: Tapered.

E. End-Wall Framing: Manufacturer's standard primary end-wall framing fabricated for field-bolted assembly to comply with the following:

1. End-Wall and Corner Columns: I-shaped sections fabricated from structural-steel shapes; shop-welded, built-up steel plates; or C-shaped, cold-formed, structural-steel sheet.
2. End-Wall Rafters: C-shaped, cold-formed, structural-steel sheet; or I-shaped sections fabricated from shop-welded, built-up steel plates or structural-steel shapes.

F. Secondary Framing: Manufacturer's standard secondary framing, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Unless otherwise indicated, fabricate framing from either cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet, prepainted with coil coating, to comply with the following:

1. Purlins: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; minimum 2-1/2-inch wide flanges.
   a. Depth: As needed to comply with system performance requirements.
2. Purlins: Steel joists of depths indicated on Drawings.

3. Girts: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees from flange, with minimum 2-1/2-inch wide flanges.
   a. Depth: As required to comply with system performance requirements.
4. Eave Struts: Unequal-flange, C-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; to provide adequate backup for metal panels.
5. Flange Bracing: Minimum 2-by-2-by-1/8-inch structural-steel angles or 1-inch diameter, cold-formed structural tubing to stiffen primary-frame flanges.
6. Sag Bracing: Minimum 1-by-1-by-1/8-inch structural-steel angles.
7. Base or Sill Angles: Manufacturer's standard base angle, minimum 3-by-2-inch, fabricated from zinc-coated (galvanized) steel sheet.
8. Purlin and Girt Clips: Manufacturer's standard clips fabricated from steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
9. Framing for Openings: Channel shapes; fabricated from cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings and head, jamb, and sill of other openings.
10. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.

G. Bracing: Provide adjustable wind bracing as follows:

1. Rods: ASTM A36/A36M; ASTM A572/A572M, Grade 50; or ASTM A529/A529M, Grade 50; minimum 1/2-inch diameter steel; threaded full length or threaded a minimum of 6 inches at each end.
2. Cable: ASTM A475, minimum 1/4-inch diameter, extra-high-strength grade, Class B, zinc-coated, seven-strand steel; with threaded end anchors.
3. Angles: Fabricated from structural-steel shapes to match primary framing, of size required to withstand design loads.
4. Rigid Portal Frames: Fabricated from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
5. Fixed-Base Columns: Fabricated from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
6. Diaphragm Action of Metal Panels: Design metal building to resist wind forces through diaphragm action of metal panels.

H. Anchor Rods: Headed anchor rods as indicated in Anchor Rod Plan for attachment of metal building to foundation.

I. Materials:

1. W-Shapes: ASTM A992/A992M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
2. Channels, Angles, M-Shapes, and S-Shapes: ASTM A36/A36M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
3. Plate and Bar: ASTM A36/A36M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
4. Steel Pipe: ASTM A53/A53M, Type E or S, Grade B.
5. Cold-Formed Hollow Structural Sections: ASTM A500, Grade B or C, structural tubing.
6. Structural-Steel Sheet: Hot-rolled, ASTM A1011/A1011M, Structural Steel (SS), Grades 30 through 55, or High-Strength Low-Alloy Steel (HSLAS) or High-Strength Low-Alloy

Steel with Improved Formability (HSLAS-F), Grades 45 through 70; or cold-rolled, ASTM A1008/A1008M, Structural Steel (SS), Grades 25 through 80, or HSLAS, Grades 45 through 70.

7. Metallic-Coated Steel Sheet: ASTM A653/A653M, SS, Grades 33 through 80, or HSLAS or HSLAS-F, Grades 50 through 80; with G60 coating designation; mill phosphatized.
8. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A755/A755M.
    a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, SS, Grades 33 through 80, or HSLAS or HSLAS-F, Grades 50 through 80; with G90 coating designation.
    b. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A792M, SS, Grade 50 or 80; with Class AZ50 coating.
9. Steel Joists: Manufactured according to "Standard Specifications for Open Web Steel Joists, K-Series," in SJI's "Standard Specifications and Load Tables for Steel Joists and Joist Girders"; with steel-angle, top- and bottom-chord members, and end- and top-chord arrangements as indicated on Drawings and required for secondary framing.
10. Non-High-Strength Bolts, Nuts, and Washers: ASTM A307, Grade A, carbon-steel, hex-head bolts; ASTM A563 carbon-steel hex nuts; and ASTM F844 plain (flat) steel washers.
    a. Finish: Plain.
11. Structural Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A563 heavy-hex carbon-steel nuts; and ASTM F436 hardened carbon-steel washers.
    a. Finish: Plain.
12. High-Strength Bolts, Nuts, and Washers: ASTM A 490, Type 1, heavy-hex steel structural bolts; ASTM A563 heavy-hex carbon-steel nuts; and ASTM F436 hardened carbon-steel washers; all with plain finish.
13. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F1852, Type 1, heavy-hex head steel structural bolts with splined ends.
    a. Finish: Plain.
14. Unheaded Anchor Rods: ASTM F1554, Grade 36.
    a. Configuration: Straight.
    b. Nuts: ASTM A563 hex carbon steel.
    c. Plate Washers: ASTM A36/A36M carbon steel.
    d. Washers: ASTM F436 hardened carbon steel.
    e. Finish: Plain.
15. Headed Anchor Rods: ASTM F1554, Grade 36.
    a. Configuration: Straight.
    b. Nuts: ASTM A563 hex carbon steel.
    c. Plate Washers: ASTM A36/A36M carbon steel.
    d. Washers: ASTM F436 hardened carbon steel.
    e. Finish: Plain.
16. Threaded Rods: ASTM A307, Grade A.
    a. Nuts: ASTM A563 hex carbon steel.
    b. Washers: ASTM A36/A36M carbon steel.
    c. Finish: Plain.

J. Finish: Factory primed. Apply specified primer immediately after cleaning and pretreating.

1. Clean and prepare in accordance with SSPC-SP2.

2. Coat with manufacturer's standard primer. Apply primer to primary and secondary framing to a minimum dry film thickness of 1 mil.
   a. Prime secondary framing formed from uncoated steel sheet to a minimum dry film thickness of 0.5 mil on each side.

2.5 METAL ROOF PANELS

A. Standing-Seam, Metal Roof Panels: Formed with ribs to match the existing adjacent roof; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels.

1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
   a. Exterior Finish: Three-coat fluoropolymer.
   b. Color: As selected by Architect from manufacturer’s full range.
2. Joint Type: Mechanically seamed.
3. Panel Coverage: 16 inches.
4. Panel Height: 2 inches.

B. Finishes:

1. Exposed Coil-Coated Finish:
   a. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   b. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a minimum dry film thickness of 0.2 mil for primer and 0.8 mil for topcoat.
2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

2.6 METAL WALL PANELS

A. Concealed-Fastener, Flush-Profile, Exterior Metal Wall Panels: Formed with vertical panel edges and flush surface; with flush joint between panels; with 1-inch wide flange for attaching interior finish; designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps.

1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
   a. Exterior Finish: Fluoropolymer.
   b. Color: As selected by Architect from manufacturer’s full range.
2. Panel Coverage: 16 inches.
3. Panel Height: 3 inches.

B. Tapered-Rib, Metal Interior Liner Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.

1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
   a. Exterior Finish: Siliconized polyester.
   b. Color: As selected by Architect from manufacturer's full range.
2. Major-Rib Spacing: Manufacturer's standard.
3. Panel Coverage: Manufacturer's standard.
4. Panel Height: Manufacturer's standard.

2.7 THERMAL INSULATION

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Bay Insulation Systems, Inc., Green Bay, WI, 54311

B. The SkyLiner® System consists of the following materials:

1. Unfaced light density fiberglass metal building insulation in one of the following product categories:
   a. Metal Building Insulation.
      1) Complies with ASTM C991 Type 1.
      2) Complies with NAIMA 202-96-REV 2000.
      3) Flame Spread Index <25 and Smoke Developed Index <50 when tested in accordance with ASTM E84, NFPA 255 and UL 723.
      4) Certified by SCS Global Services to contain a minimum of 65% recycled glass content, 18% pre-consumer and 47% post-consumer.
      5) Thermal Resistance: Available R-Values = R11, R25 or R32.5.
      6) Unfaced.
      7) GREENGUARD Indoor Air Quality Certified®.
      8) GREENGUARD Gold Certified.
2. Fabric liner facing/vapor barrier composed of woven high-density polyethylene coated on both sides with polyethylene. Complies with the following:
   a. ASTM C1136, Types I through VI.
   b. Type 1-IV exception for dimensional stability (value is <2.0%).
   c. Perm rating: 0.02 or 0.03 when tested in accordance with ASTM E 96 Procedure A.
   d. Flame Spread Index < 25 and Smoke Developed Index < 50 when tested in accordance with ASTM E 84.
   e. Color:
      1) Bright White, Sky Blue Backing.
3. Vapor barrier adhesive. Complies with the following:
   a. BayGrip™ Contact Adhesive; CA Compliant.
   b. BayGrip™ Fast Dry Pressure Sensitive Adhesive; CA Compliant.
4. Double sided vapor barrier tape. Complies with the following:

a. SkyLiner Double-Faced Tape.
b. 2” width.

5. Patch tape. Complies with the following:
   a. SkyLiner Repair Tape.
6. Metal Banding/Straps. Complies with the following:
   a. SkyLiner® Banding, 1” x 0.023 continuous length metal banding.
   b. Exposed color to match vapor barrier.
      1) White.
7. Thermal breaks.
   a. Closed cell polyethylene foam tape for wall applications. Complies with the following:
      1) 0.125” thick to 0.375” thick.
      2) 3.0” wide.
   b. Thermal spacer blocks. Complies with the following:
      1) Extruded or expanded polystyrene.
      2) Minimum width 3.0”.
      3) Thickness 0.5” to 1.0”.
8. Fasteners & Clips.
   a. SkyLiner® Safety Clip System, to include offset clip + fastener + banding, 16” either side of each frame. (Required for fall protection installation.)
   b. Tek 2 and Tek 4.5.
9. Insulation Hangars.
   a. SkyLiner® SkyHook™ for Walls.
   b. SkyLiner® Insul-Hold for Walls, insulation hangars.

2.8 ACCESSORIES

A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.

1. Form exposed sheet metal accessories that are without excessive oil-canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same material as metal roof panels.
2. Clips: Manufacturer's standard, designed to withstand negative-load requirements.
3. Cleats: Manufacturer's standard, mechanically seamed cleats.
4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.

5. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
6. Thermal Spacer Blocks: Where metal panels attach directly to purlins, provide thermal spacer blocks of thickness required to provide 1-inch standoff; fabricated from extruded polystyrene.

C. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including copings, fasciae, mullions, sills, corner units, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels unless otherwise indicated.

1. Closures: Provide closures at eaves and rakes, fabricated of same material as metal wall panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

D. Flashing and Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match adjacent metal panels.

1. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.
2. Opening Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch (0.46-mm) nominal uncoated steel thickness, prepainted with coil coating. Trim head and jamb of door openings, and head, jamb, and sill of other openings.

E. Gutters: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match roof fascia and rake trim. Match profile of existing gutters, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch long sections, sized according to SMACNA's "Architectural Sheet Metal Manual."

1. Gutter Supports: Fabricated from same material and finish as gutters.
2. Strainers: Bronze, copper, or aluminum wire ball type at outlets.

F. Downspouts: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match metal wall panels. Open faced downspouts to match existing building. Fabricate in minimum 10-foot long sections, complete with formed elbows and offsets.

1. Mounting Straps: Fabricated from same material and finish as gutters.

G. Roof Curbs: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.048-inch nominal uncoated steel thickness prepainted with coil coating; finished to match metal roof panels; with welded top box and bottom skirt, and integral full-length cricket; capable of withstanding loads of size and height indicated.

1. Curb Subframing: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.060-inch nominal uncoated steel thickness, angle-, C-, or Z-shaped metallic-coated steel sheet.
2. Insulation: 1-inch thick, rigid type.

H. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.

I. Materials:

1. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.
   a. Fasteners for Metal Roof Panels: Self-drilling, Type 410 stainless steel or self-tapping, Type 304 stainless-steel or zinc-alloy-steel hex washer head, with EPDM washer under heads of fasteners bearing on weather side of metal panels.
   b. Fasteners for Metal Wall Panels: Self-drilling, Type 410 stainless steel or self-tapping, Type 304 stainless-steel or zinc-alloy-steel hex washer head, with EPDM sealing washers bearing on weather side of metal panels.
   c. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
   d. Blind Fasteners: High-strength aluminum or stainless-steel rivets.
2. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
3. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
4. Metal Panel Sealants:
   a. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene-compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape of manufacturer's standard size.
   b. Joint Sealant: ASTM C920; one part elastomeric polyurethane or polysulfide; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended by metal building system manufacturer.

2.9 FABRICATION

A. General: Design components and field connections required for erection to permit easy assembly.

1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members shall be free of cracks, tears, and ruptures.

B. Tolerances: Comply with MBMA's "Metal Building Systems Manual" for fabrication and erection tolerances.

C. Primary Framing: Shop fabricate framing components to indicated size and section, with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.

1. Make shop connections by welding or by using high-strength bolts.
2. Join flanges to webs of built-up members by a continuous, submerged arc-welding process.
3. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin web or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
4. Weld clips to frames for attaching secondary framing if applicable, or punch for bolts.
5. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary framing with specified primer after fabrication.

D. Secondary Framing: Shop fabricate framing components to indicated size and section by roll forming or break forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.

1. Make shop connections by welding or by using non-high-strength bolts.
2. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP 2. Shop prime uncoated secondary framing with specified primer after fabrication.

E. Metal Panels: Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.

1. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

2.10 SOURCE QUALITY CONTROL

A. Special Inspection: Owner will engage a qualified special inspector to perform source quality control inspections and to submit reports.

1. Accredited Manufacturers: Special inspections will not be required if fabrication is performed by an IAS AC472-accredited manufacturer approved by authorities having jurisdiction to perform such Work without special inspection.
   a. After fabrication, submit copy of certificate of compliance to authorities having jurisdiction, certifying that Work was performed according to Contract requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with erector present, for compliance with requirements and metal building system manufacturer's tolerances.

1. Engage land surveyor to perform surveying.

C. Proceed with erection only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.

B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION OF STRUCTURAL FRAMING

A. Erect metal building system according to manufacturer's written instructions and drawings.

B. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.

C. Set structural framing accurately in locations and to elevations indicated, according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.

D. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure will be completed and in service.

F. Primary Framing and End Walls: Erect framing level, plumb, rigid, secure, and true to line. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist-cure grout for not less than seven days after placement.

1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt type and joint type specified.
   a. Joint Type: Snug tightened or pretensioned as required by manufacturer.

G. Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.

1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
2. Locate and space wall girts to suit openings such as doors and windows.
3. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.

H. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.

1. Tighten rod and cable bracing to avoid sag.
2. Locate interior end-bay bracing only where indicated.

I. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.

J. Erection Tolerances: Maintain erection tolerances of structural framing within AISC 303.

3.4 METAL PANEL INSTALLATION, GENERAL

A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

C. Examination: Examine primary and secondary framing to verify that structural-panel support members and anchorages have been installed within alignment tolerances required by manufacturer.

1. Examine roughing-in for components and systems penetrating metal panels, to verify actual locations of penetrations relative to seams before metal panel installation.

D. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes.
   a. Field cutting of metal panels by torch is not permitted unless approved in writing by manufacturer.
2. Install metal panels perpendicular to structural supports unless otherwise indicated.
3. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Locate metal panel splices over structural supports with end laps in alignment.
6. Lap metal flashing over metal panels to allow moisture to run over and off the material.

E. Lap-Seam Metal Panels: Install screw fasteners using power tools with controlled torque adjusted to compress EPDM washers tightly without damage to washers, screw threads, or metal panels. Install screws in predrilled holes.

1. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply metal panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.

F. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.

G. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated; or, if not indicated, provide types recommended by metal panel manufacturer.

1. Seal metal panel end laps with double beads of tape or sealant the full width of panel. Seal side joints where recommended by metal panel manufacturer.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

3.5 METAL ROOF PANEL INSTALLATION

A. General: Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.

1. Install ridge caps as metal roof panel work proceeds.
2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.

B. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint, at location and spacing and with fasteners recommended by manufacturer.

1. Install clips to supports with self-drilling or self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so that clip, metal roof panel, and factory-applied sealant are completely engaged.
4. Rigidly fasten eave end of metal roof panels and allow ridge end free movement for thermal expansion and contraction. Predrill panels for fasteners.
5. Provide metal closures at peaks, rake edges, rake walls and each side of ridge caps.

C. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws. Flash and seal metal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

3.6 METAL WALL PANEL INSTALLATION

A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts, extending full height of building, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Unless otherwise indicated, begin metal panel installation at corners with center of rib lined up with line of framing.
2. Shim or otherwise plumb substrates receiving metal wall panels.
3. When two rows of metal panels are required, lap panels 4 inches minimum.
4. When building height requires two rows of metal panels at gable ends, align lap of gable panels over metal wall panels at eave height.
5. Rigidly fasten base end of metal wall panels and allow eave end free movement for thermal expansion and contraction. Predrill panels.
6. Flash and seal metal wall panels with weather closures at eaves and rakes, and at perimeter of all openings. Fasten with self-tapping screws.
7. Install screw fasteners in predrilled holes.
8. Install flashing and trim as metal wall panel work proceeds.
9. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated on Drawings; if not indicated, as necessary for waterproofing.
10. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws.

11. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.

B. Metal Wall Panels: Install metal wall panels on exterior side of girts. Attach metal wall panels to supports with fasteners as recommended by manufacturer.

3.7 THERMAL INSULATION INSTALLATION

A. Install liner system in accordance with manufacturer's installation instructions and approved shop drawings.
B. Purlin and girt attachment surfaces should be clean and dry prior to attaching two-faced tape or sealing adhesive.
C. Installed fiberglass insulation should fit snugly against purlin and girt walls in the cavity space. Avoid gaps, voids, and any excess compression.

3.8 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal roof panel assembly, including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
2. Install components for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
3. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without excessive oil-canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

C. Gutters: Join sections with riveted-and-soldered or lapped-and-sealed joints. Attach gutters to eave with gutter hangers spaced as required for gutter size, but not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

D. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.

1. Provide elbows at base of downspouts to direct water away from building.

E. Roof Curbs: Install curbs at locations indicated on Drawings. Install flashing around bases where they meet metal roof panels.

F. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

3.9 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform field quality control special inspections and to submit reports.

B. Product will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 CLEANING AND PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

B. Touchup Painting: After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing, bearing plates, and accessories.

1. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or by SSPC-SP 3, "Power Tool Cleaning."
2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

C. Metal Panels: Remove temporary protective coverings and strippable films, if any, as metal panels are installed. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

1. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 133419

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SECTION 210500 - FIRE SUPPRESSION REQUIREMENTS

PART 1 - GENERAL PROVISIONS

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work under this Section.

B. This Section applies to all Division 21 sections of fire suppression.

C. The Contractor performing the work of this Section applies to the pipe fitter licensed and certified per the State of Wisconsin requirements.

1.2 APPLICABLE PUBLICATIONS

A. Publications, standards and listing requirements called out in the Sections of this Division of Labor shall form a part of these specifications as if contained herein.

B. The requirements of the Contract Documents, including the General Conditions, and Supplementary Conditions, and Division 01 - General Requirements, apply to this section except as modified herein.

1.3 DESCRIPTION OF WORK

A. Requirements of Instructions to Bidders Conditions of Contract and Division 1 - General Requirements apply to Work under this Division, which shall include:

1. Section 21 05 00 – Fire Suppression Requirements
2. Section 21 05 05 – Through-Penetration Firestopping
3. Section 21 10 00 – Automatic Water Base Sprinkler System

B. Work Included:

1. The work covered by this Division of the specifications includes the furnishing of all labor, materials, tools, equipment, permits, certificates and temporary connection necessary for or incidental to executing and completing the fire suppression work to make the system ready for normal and proper operation, including all work or materials not directly shown on the drawings or in the specifications, but necessary for the proper operation of the system.
2. All work shall be as specified and indicated on the drawings unless specifically excepted on the drawings or herein and in compliance with the State of Wisconsin Uniform Building Code, NFPA standards, Local Codes and Ordinances, Local Utility Regulations and OSHA.
3. All work shall be performed by individuals' license and certified per the State of Wisconsin requirements. Their work shall be performed to the satisfaction of the Architect / Engineer, and Owner.

4. Read all other Divisions of the Specifications which are applicable to this work, including the General Conditions section applicable to all bidders.
5. This section is a supplement to and not a replacement for the project General Condition's section.
6. In cases of conflict with information in the General Conditions, the more stringent of the contract requirements shall be considered applicable.
7. Prior to submitting bid, call to the attention of the Engineer any material or apparatus believed to be inadequate or any necessary items or work omitted.
8. Address any questions regarding the interpretation of the plans and/or specifications at least 12 days before the bid opening.
9. The Engineer reserves the right to interpret his own specifications and plans after bids are received, and to demand that the installation conform to his intent.
10. All piping is to be concealed. If building construction does not permit the concealing of piping, locations and routing are to be approved by Architect / Engineer prior to installation. Route piping in structural webbing of floor/ceiling joist in areas where piping is exposed. It is the responsibility of the contractor to verify the routing of all piping, devices, fixtures and equipment with other trades.
11. No work shall be completed and no prefabrication started until Architect / Engineer has reviewed and approved shop drawings and coordinated pipe routing with other trades.

C. Examination of Plans, Specifications and Site:

1. Before submitting a bid, the bidder shall familiarize himself with all features of the building and site which may affect the execution of his work.
2. No extra payment will be allowed for the failure to obtain this information.
3. If there are omissions or errors in the plans or specifications, they shall be clarified with the architect prior to submitting bid.

D. Codes, Permits, and Inspection Fees

1. All work and materials shall conform in every respect to the current rules and requirements of the State of Wisconsin Uniform Building Code, NFPA standards, Local Codes and Ordinances, Local Utility Regulations and OSHA.
2. Give to the proper authorities all required notices relating to the project, obtain all official permits and licenses required, pay all fees incidental thereto, deliver upon completion of the work and without cost to the Owner all required certificates of inspection and approval.
3. Secure all local permits, utility fees and licenses applicable for the work under this Division and pay all fees, including posting all bonds incidental thereto. Plan review submittal to the State of Wisconsin Department of Safety and Professional Services or its designated municipality, shall be by the Contractor.

E. Scope of Work:

1. This specification for a fire protection system is a "Performance" specification. It is intended to establish the design criteria for the work. The Fire Protection Contractor shall assume full responsibility for the design and details to meet the requirements of the State of Wisconsin, local municipality, NFPA Codes, H.S.S. Code and Factory Mutual I.R.I. or Owners insurance service.
2. Furnish all labor, materials, equipment and performing all operations necessary to install the automatic fire sprinkler system, including piping, fittings, sprinkler heads, valves,

controls, alarms, hangers, supports and any other supplemental items necessary to complete the system.

1.4 RELATED WORK ELSEWHERE

A. Thoroughly inspect the entire set of plans and specifications as to the class of building construction in general and specifically to the items of other divisions that affect the work of this Division.

B. Work of this Division also includes any fire protection work shown on the drawings and included in the specifications of other Divisions.

C. Drawings and specifications of the work under this Division are intended for a complete project. If trade jurisdiction requires portions of the work be done by other tradesmen, this Division's contractor shall sublet those portions of the work to qualified contractors, however this Division's contractor shall be held fully responsible for all such installations.

1.5 SHOP DRAWINGS

A. Submit shop drawings for all equipment and systems as indicated in the specification. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number, as indicated in the contract documents.

B. Submit electronic files with dimensions, capacities, and information as soon as available from the list of acceptable manufacturers.

C. Shop drawings shall include, but are not limited to, the following items:

1. State Approved Fire Suppression Drawing, Specifications and Hydraulic Calculations.
2. Sprinkler Heads
3. Fire Department Connection
4. Backflow Preventers.
5. Flow Switch
6. Pipe, Fittings, and Valves.
7. Pipe Hangers / Support.
8. Pipe Labels, and Valve Tags.

D. The Architect, Engineer or its representative shall review and comment on all items being submitted and items to be installed. The Architect, Engineer or its representative holds the right to request submitted items to be revised and resubmitted or to reject a submitted item if it does not meet the conformity with the design concept of the work as established in the Contract Documents.

E. All shop drawings, product data, and samples submittals shall illustrate details of the work, fixtures, equipment, materials, products, systems, designs or workmanship that this Division's contractor intends to use in order to comply with the design concept established in the Contract Documents. Review of these submittals by the Architect, Engineer or its representative is only for the limited purpose of checking for conformity with the design concept of the work as established in the Contract Documents, and is not intended to be for the purpose of determining

the accuracy of other matters that may be contained in such submittals, including, but not limited to such matters as dimensions, quantities, performance of fixtures, equipment and systems design and installed, engineering and design, construction means, methods, techniques, sequences, procedures or safety precautions, the correctness of which as set forth in the Contract Documents or submittal shall be the sole responsibility of by this Division's contractor.

F. Any flagged deviations on the shop drawings from the specified item and any approval of the shop drawings will not be considered acceptance of the deviation unless it's been explicitly flagged.

G. Where any specific fixture, equipment, materials, process or method of construction is specified by name or by reference to the model number of a manufacturer, the specifications are to be used as a guide and are not intended to take precedence over the basic duty and performance specified or noted on the drawings.

1.6 OPERATION & MAINTENANCE MANUALS

A. Submit operation and maintenance manuals following Section specific shop drawing submittal guidelines.

1. Upon the complete installation of the work under this Division, this Division's contractor shall provide the necessary qualified personnel for operating the systems as directed by and scheduled with the Architect, Engineer and the Owner. At this time, this Division's contractor shall instruct the Owner or his representative in the operation, adjustment and maintenance of all equipment furnished.
2. Provide (1) electronic and three (3) paper copies of maintenance manuals shall be submitted, which shall present full details for the care, maintenance, and operation of all equipment and systems.
3. Provide documentation in the operation and maintenance manual to required testing of the work under this Division.

B. Record Drawings:

1. Record drawings shall be kept daily, noting all changes and available upon demand.
2. Record drawings shall reflect any changes or pipe re-routing due to construction phasing or existing field conditions.
3. Final record drawings shall be provided to Architect / Engineer and owner at the completion of the project. Final record drawing shall be submitted in electronic PDF form (not hand written mark-ups) or recorded in CAD / BIM format with the ability to extract an electric PDF.

1.7 QUALITY ASSURANCE

A. All products and materials used are to be new, undamaged, clean and in good condition. Existing products and materials are not to be reused unless specifically indicated.

B. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings or engineering parameters from those indicated on the contract documents, the Contractor is responsible for all costs involved in integrating the equipment or accessories

into the system and for obtaining the intended performance from the system into which these items are placed.

C. Provide all necessary accessories required for a complete and operable system.

1.8 WARRANTY

A. The Work of this Division shall be guaranteed, in writing, to be free from defects in materials and/or workmanship for one (1) year from the date of certificate of completion and acceptance of the work. Necessary instruction and/or emergency services to be performed as a result of defects in materials or workmanship shall be furnished for one (1) year at no extra cost for labor or materials. If default thereof, the Owner may have such work done and charge all applicable costs to the Contractor.

B. Furnish manufacturer's written warranties on all equipment to the Owner stating effective date of warranty.

C. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

PART 2 - PRODUCTS

2.1 GENERAL

A. It is the intent of these specifications that all the necessary material, apparatus, and devices to complete the installation as specified herein, except such parts as are specifically accepted, shall be provided.

B. If an item is either shown on the drawings or called for in these specifications, shall be considered sufficient as an item part of this contract.

C. All materials, products, fixtures and equipment shall be an approved product per the State of Wisconsin Department of Safety and Professional Services.

D. All sizes given are as minimum.

E. Material and labor shall be first class and workmanlike and to the satisfaction of the Plumbing Engineer and shall be subject to inspection test and approval at all times from commencement until acceptance of completed work.

F. Manufacturers shall be responsible for providing material listed by U.L. or other approved agencies, and all governing codes and ordinances.

G. All material must bear U.L. and/or other approved labels where possible.

H. Items specified by catalog number or brand name and approval of shop drawings will not relieve the manufacturer of this responsibility.

2.2 HANGERS, ANCHORS AND INSERTS

A. See Pipe Hangers, Supports and Insulation Detail.

B. All piping in the piping system shall be supported with hangers in accordance with the provisions of the Wisconsin Building Code.

C. The use of perforated strap hangers will not be acceptable.

D. Use approved malleable, wrought iron or steel pipe riser clamps for steel or cast iron pipes and copper plated clamps for copper pipes.

E. Provide all necessary inserts for supporting piping and equipment.

F. Piping shall be supported with clevis or adjustable band loop hangers at intervals recommended by the manufacturer.

G. Provide low compressive insulation protectors on all insulated piping supported by hangers or strut channel. Protective shield material shall be galvanized carbon steel with pre-insulated calcium silicate support blocks.

H. Manufacturers shall be as listed above, B-Line, Anvil, Fee & Mason, Elcen or an acceptable approved equal approved by the engineer. No private label wholesale products will be accepted.

2.3 SUPPORTS

A. See Pipe Hangers, Supports and Insulation Detail.

B. Provide all structural supports required for equipment included under this Division of the Work.

C. Structural supports that is required for the installation of the system specified shall be done and repaired by this Division’s contractor in coordination with the general contractor and under the direction and to the satisfaction of the Architect and Engineer.

D. Manufacturers shall be as listed above, B-Line, Anvil, Fee & Mason, Elcen or an acceptable approved equal approved by the engineer. No private label wholesale products will be accepted.

2.4 ESCUTCHEONS

A. See Pipe Penetration Detail.

B. Provide on all pipes passing through finished floors, walls and ceilings with outside diameter sufficient to cover sleeve opening and inside diameter to fit snugly around pipe.

C. Escutcheon plates shall be chrome plated brass.

D. Manufacturers shall be as listed above, BrassCraft, Dearborn, Keeney, McGuire or an acceptable approved equal approved by the engineer. No private label wholesale products will be accepted.

2.5 ACCESS PANELS

A. Provide access panels with a key locking device and sized as required for the access to all valves, etc.

B. Panels shall be installed by Fire Protection Contractor in openings provided by the General Contractor as located and supervised by this Division.

C. Manufacturers shall be as listed above, KARP and Associates, Milcor, Titus or an acceptable approved equal approved by the engineer. No private label wholesale products will be accepted.

2.6 IDENTIFICATION

A. All equipment, pipe and valves, etc., shall be identified as listed below.

B. All piping in this Division of the Work exposed, in access spaces or above ceilings shall be identified at minimum of 25' intervals and at least once in every room with, pipe marking labels, 2¼" color as required by A.N.S.I. standards.

C. Sprayed on pipe stencils letterings are not allowed.

D. Valve tags shall be 1 1/8" round brass tags with black numerals. Fasten tags to body of valves with copper or brass chain. Numerals on tags shall correspond to the record drawings.

E. Equipment and starters shall be identified with neat, clear, permanent labels.

F. Valve Charts:

1. Furnish three (3) charts listing all valves, giving their location in the building and describing the valve number, service, function, normal position, etc. One (1) chart encased in plastic to be mounted in the building maintenance office and the other two (2) charts delivered to the Architect for transmittal to the Owner.
2. Furnish one (1) overall floor plan showing the location of all valves and the corresponding number from the valve chart.

G. Manufacturers shall be W.H. Brady Co., Seton, or an acceptable approved equal approved by the engineer. No private label wholesale products will be accepted.

2.7 PIPE SLEEVES AND PENETRATIONS

A. See Pipe Penetration Detail.

B. Pipe sleeves and penetrations passing through fire walls, barriers, floors or ceilings shall be sealed with fire barrier caulking. 3-M Fire Barrier CP-25 caulk and 303 putty synthetic elastomers, U.L. rated.

C. Provide sleeves for pipes passing through masonry or concrete tunnels, basins equipment, walls and floors, seal all openings between pipe and sleeve with vinyl acrylic plastic.

D. Pipe sleeves passing through floors outside of chases shall be constructed of schedule 40 galvanized steel pipe ½" larger than pipe or pipe insulation and shall extend ½" above finished floors.

E. Pipe sleeves passing through walls, partitions, etc., for piping exposed to view shall be constructed of 20 gauge galvanized iron sleeves 1" larger than pipe or pipe insulation and shall extend ½" from the finished surfaces.

F. Pipe penetrations passing through masonry or concrete that are cored and below grade or subjected to water or ground water shall have its opening 1" larger than the outside diameter of the penetrating pipe and sealed with a mechanical link-seal. Locations shall include, but not limited to, tunnels, equipment basins, walls and floors.

G. Manufacturers for fire barriers shall be U.L. listed 3-M Fire Barrier CP-25 caulk, 303 putty synthetic elastomers or an acceptable approved equal approved by the engineer.

H. Manufacturers for mechanical link-seals shall be Garlock, Trumbul, or an acceptable approved equal approved by the engineer.

PART 3 - EXECUTION

3.1 CONTINUITY OF EXISTING SERVICES

A. Do not interrupt or change existing services without prior written approval from the Owner's construction representative. When interruption is required, coordinate scheduling of downtime with the Owner to minimize disruption to his activities. Unless specifically stated, all work involved in interrupting or changing existing services is to be done during normal working hours.

B. The Contractor shall notify building occupants and also local fire authorities of any shutdowns of the existing system.

3.2 EXAMINATION

A. Verify fixtures and equipment are in compliance with approved submittal drawings.

3.3 FIELD MEASUREMENTS

A. Field verify all measurements. Do not base on drawings.

B. Identify conflicts with the work of other trades prior to installation of work.

C. Adjust system to satisfy field requirements.

3.4 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Maintain original quality and condition of equipment while it is in storage.

3.5 INSTALLATION

A. General:

1. The complete installation of the work under this Division shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer's recommendations.
2. Install all materials, assemblies, fixtures and equipment in per the manufacturer's recommendations and requirements. Consult manufacturer as required for missing information and technical advice of that product.
3. All equipment, tools, pipe, fittings and valves required for construction, phases of construction, and the "means and methods" of construction shall be provided this Division's contractor.
4. Exposed piping is to be painted by Painting Contractor. This Division Contractor shall protect sprinkler heads and equipment from painting in exposed areas.

B. Electrical Coordination

1. Electrical Contractor will furnished and install all power wiring to control panels, valves, low voltage transformer box, , fixtures, equipment and other devices furnished by this Division's contractor that is required for the operation of the piping system.
2. Provide manufacturer's wiring diagrams to Electrical Contractor for all equipment and devices furnished by this Division's contractor and as indicated to be wired by the Electrical Contractor.

C. Piping:

1. All installation to be installed per the local and state of Wisconsin Building code and NFPA standards.
2. Underground piping shall be laid on 4" of bedding sand or pea gravel to support pipe evenly and avoid hubs supporting piping. All installations shall be constructed in an approved manner to the complete satisfaction of the Architect and Engineer.
3. Avoid locating any piping over electrical equipment or in elevator equipment rooms.
4. All valves and valve handles shall be installed in an accessible location. Valve handles shall operate so that pulling down will close the valve. Space associated piping as required for proper operation.
5. Conceal all piping whenever possible. Install all piping so that it can be drained, and provide a brass drain plug at low points and at the bottom of risers.
6. All pressure gauges shall be located so they can be viewed from the floor and in the upright position.
7. All installation to be installed per the local and state codes.
8. All piping shall be installed in parallel with the building's structure.
9. All horizontal piping shall be installed level.
10. All vertical piping shall be installed plumb.
11. Avoid locating any piping over electrical equipment or in elevator equipment rooms.
12. All valves and valve handles shall be installed in an accessible location. Valve handles shall operate so that pulling down will close the valve. Provide adequate spacing between piping for proper operation of valves and for service and maintenance.

13. Conceal all piping whenever possible. Bring stub extensions as close to fixtures as possible. Install all piping so that it can be drained, and provide a brass drain plug at low points and at the bottom of risers.
14. Piping within A Plenum Ceiling:

    a. Piping within the plenum ceiling shall be of non-combustible material or shall have a flame spread index of not more than 25 and a smoke−developed index of not more than 50 when tested in accordance with ASTM E84, CAN/ULC S102.2 or UL 723 with the exception of combustible materials fully enclosed within continuous noncombustible raceways or enclosures, or within materials listed and labeled for such application.

D. Diagrams, Measurements, Final Layout Drawings:

1. Drawings show the layout in general and approximate locations of piping, major equipment, etc., and shall be followed as closely as the actual construction of the building, work of other trades, and the locations of equipment will permit.
2. All changes from the drawings necessary to make the work under this Division conform to the building as constructed and to fit the work of other trades shall be made without extra cost.
3. Drawings for the work under this Division shall not be scaled for exact dimensions. Consult the architectural and structural drawings and details for all dimensions and location of the work under this Division.

E. Protection of Finished Work and Materials:

1. Protect all materials and work performed under this Division from damage or injury that may be caused by other workmen and from the action of the elements.
2. Protect the materials and work performed by other Divisions, and the Owner’s property from damage or injury arising from work under this Division.
3. Keep all piping and equipment capped, plugged, drained, or otherwise protected including protection from freezing and by stoppage from building materials, sand or dirt, mortar, concrete, etc.

F. Painting

1. Exposed piping is to be painted by Painting Contractor. This Division Contractor shall protect sprinkler heads and equipment from painting in exposed areas.

G. Cleaning and Finishing:

1. After all work under this Division have been made and the system pronounced as satisfactory, this Division’s contractor shall go over all his work and clean equipment, fixtures, piping, etc. and leave clean and in complete working order at final completion of the building.
2. The putting of new work, or any part thereof, into use, even though with the Owner’s consent, shall not be construed to be an acceptance of the work on the part of the Owner, nor shall it be construed to obligate him, in any way, to accept improper work or defective material.

H. Cooperation with Other Divisions and the Owner:

1. Give full cooperation to other trades and furnish any information necessary to permit the work of all trades to be installed satisfactorily and with least possible interference or delay.
2. The Work of this Division must be coordinated with the work of other Divisions and the Owner to prevent interference. Any necessary changes to be made because of the lack of proper coordination shall be performed without extra charge.
3. Where the work of this Division will be installed in close proximity to the work of other trades, or where there is evidence that the work of this Division's contractor will interfere with work of other trades, they shall assist in working out space conditions to make a satisfactory adjustment.
4. Coordinate work of this Division so the installation of the piping and supports do not conflict with electrical code required clearances or in elevator hoist ways or equipment rooms. Piping systems are shown to be approximate on plans. Exact locations of equipment must be coordinated by this Division's contractor with other trades prior to installation.
5. Provide manufacturer's wiring diagrams to Electrical Contractor for all equipment and devices furnished by this Division's contractor and as indicated to be wired by the Electrical Contractor.
6. Furnish and install the tamper switches and flow switch.
7. Furnish the interior and exterior alarm bells, the strobe lights, and alarm control panel as required for the piping system and provide to the Electrical Contractor, who shall install and wire these items.
8. Electrical Contractor will furnish and install all power wiring to control panels, valves, fixtures, equipment and other devices furnished by this Division's contractor that is required for the operation of the piping system.
9. If this Division's contractor installs their work before coordinating it with other trades, they shall make necessary changes in their work to correct the condition without extra charge.
10. Provide all service connections under the jurisdiction of the work under this Division to Owner's equipment or equipment furnished by other Divisions as required for a complete and operating installation.

I. Supervision:

1. Provide the services of an experienced superintendent who shall be constantly in charge of all the work included in or related to this Division.

J. Substitutions:

1. All costs, as a result of submitted substituted items by the Contractor and with the approval by the Architect or Engineer, including costs required under other Contracts, shall be the responsibility of the Contractor requesting the substitution. None of the extra costs resulting from such approval shall evolve upon the Owner, the Architect, other Consultants, or other Contractors.

3.6 OWNER TRAINING

A. Provide as outlined in each specification section requiring owner training.

3.7 SPARE EQUIPMENT (NONE)

END OF SECTION 210500

SECTION 210505 - THROUGH-PENETRATION FIRESTOPPING

PART 1 - GENERAL PROVISIONS

1.1 APPLICABLE PROVISIONS

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

1.2 APPLICABLE PUBLICATIONS

A. Fire Test Requirements

1. ASTM E-814, “Fire Tests of Through Penetration Fire Stops”.
2. ANSI/ UL1479, “Fire Tests of Through Penetration Fire Stops”
3. ASTM E-119, “Fire Tests of Building Construction and Materials”.
4. ANSI/ UL263, “Fire Tests of Building Construction and Materials”.
5. ASTM E-84, “Surface Burning Characteristics of Building Materials”.
6. ANSI/ UL723, “Surface Burning Characteristics of Building Materials”.

B. References

1. Underwriters Laboratories (UL) of Northbrook, IL “Fire Resistance Directory”.

    a. Through Penetration Firestop Systems (XHEZ)
    b. Fill, Void or Cavity Materials (XHHW)
    c. Firestop Devices (XHJI)
    d. Forming Materials (XHKU)

2. All major building codes:

    a. International Building Code published by ICC.

3. National Fire Protection Association (NFPA) of Quincy, MA “NFPA 101: Life Safety Code”.

1.3 DESCRIPTION OF WORK

A. Furnish and install a complete firestopping installation as specified herein.

B. This section includes through-penetration firestop systems for the fire suppression system’s equipment and piping penetrations through the following fire-resistance rated assemblies, including both blank openings and openings containing penetrating items:

1. Floor-ceiling assemblies.
2. Roof-ceiling assemblies.
3. Walls and partitions.

4. Smoke barriers.
5. Construction enclosing compartmentalized areas.

1.4 RELATED WORK ELSEWHERE

A. Division 03 – Concrete

B. Division 04 – Masonry Work

C. Division 09 – Finishes

D. Division 13 – Special construction

E. Division 21 – Fire Suppression

F. Division 22 – Plumbing

G. Division 23 – Heating, Ventilation and Air Conditioning

1.5 SHOP DRAWINGS

A. Product Data: For each type of through-penetration firestop system product indicated.

B. System Drawings: Submit documentation from a qualified third-party testing agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.

C. Product Certificates: Certificate of conformance signed by manufacturers of through-penetration firestop system products certifying that products comply with requirements.

1.6 OPERATION & MAINTENANCE MANUALS (NONE)

1.7 QUALITY ASSURANCE

A. Provide through-penetration firestop systems that comply with the following requirements:

1. Firestopping tests are performed by a qualified, testing and inspection agency. A qualified testing and inspection agency is UL, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
2. Through-penetration firestop system products bear classification marking of qualified testing and inspection agency.
3. Engage an experienced installer who is certified, licensed or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install firestop products per specified requirements. A manufacturer’s willingness to sell its through-penetration firestop system products to Contractor or to an installer engaged by Contractor does not in itself confer qualifications on buyer.

B. Obtain through-penetration firestop systems for each type of penetration and construction condition indicated from a single manufacturer.

C. Through-penetration firestop systems shall be subjected to necessary inspections and tests.

D. Keep areas of work accessible until inspection by authorities having jurisdiction.

E. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

1.8 WARRANTY

A. Equipment shall be warranted for a period of not less than 1 year from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

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.

PART 2 - PRODUCTS

2.1 FIRESTOPPING, GENERAL

A. Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Provide components for each through-penetration firestop system that are needed to install fill materials. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

C. Performance Requirements

1. Provide products that upon curing do not re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during and after construction.
2. Openings within walls and floors designed to accommodate cabling systems subjected to frequent cable changes shall be provided with re-enterable products specifically designed for retrofit.

2.2 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with through-penetration firestop systems (XHEZ) listed in Volume 2 of the UL Fire Resistance Directory, provide products of the following manufacturers as identified below:

1. Manufacturers listed in the UL Fire Resistance Directory – Volume 2.

2.3 MATERIALS

A. General: Use only through-penetration firestop system products that have been tested for specific fire-resistance-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.

B. Latex Sealants: Single component latex formulations that upon cure do not re-emulsify during exposure to moisture.

C. Firestop Devices: Factory-assembled steel collars lined with intumescent material sized to fit specific outside diameter of penetrating item.

D. Firestop Putty: Intumescent, non-hardening, water resistant putties containing no solvents, inorganic fibers or silicone compounds.

E. Firestop Putty Pads: Intumescent, non-hardening putty pads to be installed on metallic and nonmetallic electrical switch and receptacle boxes to reduce horizontal separation between boxes to less than 24”.

F. Wrap Strips: Single component intumescent elastomeric strips faced on both sides with a plastic film.

G. Firestop Pillows: Re-enterable, non-curing, mineral fiber core encapsulated with an intumescent coating contained in a flame retardant poly bag.

H. Mortar: Portland cement based dry-mix product formulated for mixing with water at Project site to form a non-shrinking, water-resistant, homogenous mortar.

I. Silicone Sealants: Moisture curing, single component, silicone elastomeric sealant for horizontal surfaces (pourable or nonsag) or vertical surface (nonsag).

J. Silicone Foam: Multicomponent, silicone-based liquid elastomers, that when mixed, expand and cure in place to produce a flexible, non-shrinking foam.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.

B. Do not proceed until unsatisfactory conditions have been corrected.

3.2 FIELD MEASUREMENTS

A. Verify that field measurements are as shown on Drawings.

3.3 DELIVERY STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Accept equipment on site. Inspect for damage.

C. Protect equipment from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

D. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturer's labels identifying product and manufacturer, date of manufacture; lot number; shelf life, if applicable; qualified testing and inspection agency's classification marking; and mixing instructions for multicomponent materials.

E. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants or other causes.

3.4 INSTALLATION

A. General Requirements: Install through-penetration firestop systems in accordance with "Performance Criteria" Article and in accordance with the conditions of testing and classification as specified in the published design.

B. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration firestop systems products.

1. Seal all openings or voids made by penetrations to ensure an air and water resistant seal.
2. Protect materials from damage on surfaces subjected to traffic.

C. Remove equipment, materials and debris, leaving area in undamaged, clean condition.

D. Clean all surfaces adjacent to sealed openings to be free of excess through-penetration firestop system materials and soiling as work progresses.

E. Project conditions

1. Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limitations recommended by manufacturer.
2. Do not install through-penetration firestop systems when substrates are wet due to rain, frost, condensation, or other causes.
3. Do not use materials that contain flammable solvents.

4. Do not install water-based or products that are conductive when wet in contact with energized electrical conductors. Exercise care when energizing penetrants.

F. Coordination

1. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
2. Coordinate sizing of sleeves, openings, core-drilled holes or cut openings to accommodate through-penetration firestop systems.
3. Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.

G. Preparation

1. Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellents, and any other substances that may inhibit optimum adhesion.
2. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
3. Do not proceed until unsatisfactory conditions have been corrected.

3.5 OWNER TRAINING (NONE)

3.6 SPARE EQUIPMENT (NONE)

END OF SECTION 210505

SECTION 211000 - AUTOMATIC WATER BASE SPRINKLER SYSTEM

PART 1 - GENERAL PROVISIONS

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work under this Section.

1.2 DESCRIPTION OF WORK

A. Furnish and install a complete and operable system as indicated on the drawings and as specified herein.

B. Materials:

1. Materials shall conform to the standard prescribed in the Wisconsin building and fire Codes and be approved for use by the Department of Safety and Professional Services, Division of Technical Services. When required, Fire Protection Contractor shall obtain approval prior to installation.
2. All materials and equipment required for the work shall be new, of first-class quality and shall be furnished, delivered, erected, connected and finished in every detail and shall be so selected and arranged as to fit into the building spaces.

C. Materials Not Included:

1. N/A.

1.3 SHOP DRAWINGS

A. Submit electronic files with dimensions, capacities, and information as soon as available from manufacturers.

1.4 QUALITY ASSURANCE

A. All materials and parts shall be new and unused of current manufacture.

B. Provide all necessary accessories required for a complete and operable system.

1.5 WARRANTY

A. Materials and workmanship shall be warranted for a period of not less than (1) year from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

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.

PART 2 - PRODUCTS

2.1 AUTOMATIC WATER BASE SPRINKLER SYSTEM PIPING

A. Steel Pipe: Black steel pipe welded and seamless, Grade A, ASTM A53; black welded and seamless steel pipe for fire protection use, ASTM A795; electric resistance welded steel pipe, Grade A, ASTM A135.

1. Schedule 40 for welded, rolled groove, cut groove and threaded. Schedule 30 for welded, rolled groove, 8” and larger cut groove and 8” and larger threaded piping. Schedule 10 up to and including 6” for rolled groove and welded. 0.188” for 8” and 10” rolled groove and welded.
2. Fittings1-1/4” and Under - Cast iron threaded fittings, Class 125 or 250, ASTM A126/ANSI B16.4. Malleable iron threaded fittings, Class 150 or 300, ASTM A197/ANSI B16.3.
3. Fittings: 1-1/2” and Over - Standard weight seamless carbon steel weld fittings, ASTM A234 grade, ANSI Bl6.9. Mechanical grooved fittings with EPDM gaskets, ASTM A536 ductile iron, ASTM A47 malleable iron or ASTM A53 fabricated steel.

2.2 UNIONS AND FLANGES

A. Unions, flanges and gasket materials to have a pressure rating of not less than 175 psig.

B. 2” and Smaller Steel: ASTM A197 ANSI B16.3 malleable iron unions with brass seats. Use black malleable iron on black steel piping and galvanized malleable iron on galvanized steel piping.

C. 2½” and Larger: ASTM A181 or A105, Class 150, grade 1 hot forged steel flanges of threaded, welding neck, or slip-on pattern on black steel and threaded only on galvanized steel. ANSI B16.1 or ANSI B16.5, Class 150 cast iron threaded flanges. Use raised face flanges ANSI B16.5 for mating with other raised face flanges or equipment with flat ring or full face gaskets. Use ANSI B16.1 flat face flanges with full face gaskets for mating with other flat face flanges on equipment.

2.3 MECHANICAL GROOVED PIPE CONNECTIONS

A. Mechanical grooved pipe couplings and fittings, as manufactured by Viking, Victaulic, ITT Grinnell, Stockham or Gustin-Bacon may be used with cut steel pipe. Couplings and fittings to be malleable iron, ASTM A47, or ductile iron A536.

B. All mechanical grooved pipe material including gaskets, couplings, fittings, and flange adapters to be from the same manufacturer.

C. Gaskets shall be EPDM, ASTM D2000. Heat treated carbon steel oval neck track bolts and nuts, ASTM A-183, with zinc electroplated finish.

D. Couplings: Standard flexible couplings, Style 77, or lightweight couplings, Style 75. Reducing couplings are not acceptable.

E. Flanges: Flange adapter Style 741, except at lug type butterfly valves where standard threaded flanges shall be used.

F. Fittings: Malleable or ductile iron elbows and tees of the manufacturer's standard line may be used in all sizes, except bullhead tees will not be accepted.

2.4 PIPE HANGERS AND SUPPORTS

A. Pipe hangers and supports shall be as manufactured by B-Line, Fee and Mason. Grinnell, Pate Roof Products & Systems, Unistrut or approved equal.

B. Pipe and fittings shall be anchored, clamped and rodded as required by the Architect, Engineer, and NFPA Codes.

C. Provide all supporting steel required for the installation of mechanical equipment and materials, including angles, channels, beams, etc. to suspended or floor supported equipment. All of this steel may be specifically indicated on the drawings.

D. Hangers for pipe sizes ½" through 2" shall be carbon steel, adjustable swivel, split ring or clevis.

E. Multiple or trapeze hangers shall be steel channels with welded spacers and hanger rods.

F. Wall support for pipe sizes through 3" shall be cast iron hook and for sizes 4" and over shall be welded steel bracket and wrought steel clamp.

G. Vertical support shall be steel riser clamp.

H. Floor support shall be painted steel pipe saddle, stand and bolted floor flange.

I. Provide rods complete with adjusting and lock nuts.

J. Beam clamps shall be malleable black iron clamp for attachment to beam flange to 0.62 inches thick with a retaining ring and threaded rod of 3/8, 1/2 and 5/8 inch diameter. Furnish with a hardened steel cup point set screw or forged steel jaw type clamp with a tie rod to lock clamp in place, suitable for rod sizes to 1½ inch diameter.

K. Riser clamps shall be black carbon steel filled clamp in two section that are bolted together around the pipe. Plastic or copper coat the clamps when used on copper pipe.

L. Anchors: Use welding steel shapes, plates and bars to secure piping to the structure.

M. Equipment Stands: Use structural steel members supported by pipe supports. All steel exposed to the weather to be galvanized or stainless. All other steel to receive prime and finish coat of rust inhibiting paint.

2.5 SLEEVES

A. Sleeves. Pipe sleeves to be Schedule 40 steel pipe flush with wall and ceiling surfaces.

B. Seal all openings between pipe and sleeves with fiberglass and vinyl acrylic plastic. For piping passing through fire walls, floors or ceilings, use 3-M Fire Barrier CP-25 caulk and 303 putty synthetic elastomers, U.L. rated.

2.6 BACKFLOW PREVENTER

A. Detector check valves for fire service 3” through 12” in size shall be Underwriters’ approved as manufactures.

B. Double check valves shall be manufactured by Beeco, Cla-Vat, Febco, Watts or Wilkinson shall be ASSE 1015 double check backflow preventer with two independent spring loaded check valves, two isolation ball or gate valves, four valved test ports. Size for maximum pressure drop of 11 psig at 250 GPM. Construct of bronze or epoxy coated cast iron body with bronze and plastic internal parts, stainless steel springs, silicone rubber valve discs, bronze seats and rated for 175 psig.

2.7 VALVES

A. Valves shall be as manufactured by Kennedy, Milwaukee, Nibco, Stockham, Viking, Victaulic, ITT Grinnell, or equal, and must be approved and listed by UL or FM if applicable.

B. Gate valves 2” and smaller shall be outside screw and yoke, 175 psig, bronze body, bronze mounted, screwed bonnet, rising stem, solid wedge, with tamper switch. Gate valves 2½” and larger shall be outside screw and yoke, 175 psig, cast iron body, bronze mounted, bolted bonnet, rising stem, solid wedge, with tamper switch.

C. Butterfly valves 2” shall be bronze body butterfly, 175 psig, geared operator, visible position indicator, tamper switch, Buna or Viton seat, stainless steel disc and stem. Butterfly valves 2½” and larger shall be cast or ductile iron body butterfly, lug style, 175 psig, geared operator, visible position indicator, tamper switch, EPDM resilient seat, EPDM seals, nickel plated ductile iron disc. Valve assembly to be bubble tight to 175 psig with no downstream flange/pipe attached. Use cap screws for removal of downstream piping while using the valve for system shutoff.

D. Check valves 2” and smaller shall be bronze body, threaded end, Y-pattern, regrindable bronze seat, renewable bronze disc, 175 psig, suitable for installation in a horizontal or vertical line with flow upward. Check valves 2 ½” and larger shall be cast or ductile iron body, flanged or grooved ends, bronze trim, bolted cap, renewable bronze seat and disc, 175 psig, suitable for installation in a horizontal or vertical line with flow upward.

E. Spring loaded check valves 2" and smaller shall be bronze body, threaded ends, bronze trim, stainless steel spring, stainless steel center guide pin, 175 psig, teflon seat unless only bronze available. Spring loaded check valves 2½" and larger shall be cast or ductile iron body, wafer or globe type, bronze trim, bronze or EPDM seat, stainless steel spring, stainless steel stem if stem is required, 175 psig.

F. Drain valves shall be ½" two or three piece bronze body ball valve: threaded ends, chrome plated bronze ball; glass filled teflon seat; teflon packing and threaded packing nut; blowout-proof stem; 400 psig WOG, with hose thread outlet and cap.

G. All valves controlling the water supply for automatic sprinkler systems and water flow switches on all sprinkler systems shall be electrically supervised. Alarm, supervisory and trouble signals shall be automatically transmitted to an approved supervising station per NFPA 72.

H. Supervisory/tamper switches, for OS&Y valve or butterfly valve installations, UL/FM listed/approved, to monitor position of valve, tamper resistant cover screws, single or double SPDT switch contacts, corrosion resistant, for indoor or outdoor use, NEMA 4 & 6P enclosures.

2.8 FLOW SWITCHES

A. Vane type UL approved waterflow switch with metal enclosure, adjustable pneumatic retard and electrical characteristics compatible with alarm system.

B. Pressure Switches: Pressure actuated UL approved switch with field adjustable settings, metal enclosure and electrical characteristics compatible with alarm system.

C. Pressure gauges shall be as manufactured by Ametek/U.S. Gauge Division, Ashcroft, Marsh, H.O. Trerice or equal. Select pressure range for twice the system working pressure but not less than 200 psig. Include bronze pressure snubber and ball valve gauge cock.

D. Automatic sprinkler systems shall be monitored by an approved supervising station. The automatic fire sprinkler system shall be tied into the building fire alarm control panel per NFPA 72, or a fire alarm panel shall be provided to supervise and monitor the fire sprinkler system. The fire alarm panel shall be protected in accordance with NFPA 72 and have at least one manual pull box for testing purposes.

2.9 ALARM BELL / HORN

A. Provide a weather tight external alarm bell / horn, read painted with metal housing on the exterior of the building above the FDC location or as determined by the AHJ / fire marshal.

B. Alarm bell shall be equal to Potter PBA-AC & MBA-DC.

C. Alarm bell shall be activated by the sprinkler flow switch.

2.10 STROBE LIGHT

A. Provide a weather tight external strobe light on the exterior of the building above the FDC location or as determined by the AHJ / fire marshal.

B. Strobe lights shall be equal to Potter SH-120 Series.

C. Strobe lights shall be activated by the sprinkler flow switch.

2.11 FIRE DEPARTMENT CONNECTION

A. Manufacturer: Elkhart Brass, Potter-Roemer, W.D. Allen or equal.

B. Confirm Fire Department Connection type with Fire Department.

1. Furnish and install a 5" Storz polished brass Fire Department Connection with 30 degree downturn elbow similar to #5799 as manufactured by Potter-Roemer, Inc. or equal. Provide brass caps with chain and label as required.
2. Furnish and install a 2½" x 2½" x 4" polished brass Fire Department Connection similar to #5751-B as manufactured by Potter-Roemer, Inc. or equal. Provide brass caps with chain and label as required.

C. Provide 24" automatic drip drain valve on inlet of Fire Department Connection.

2.12 SPRINKLERS

A. Sprinklers shall be as manufactured by TYCO, Grinnell, Reliable, Viking or Victaulic,

B. Fusible link or glass bulb, cast brass or bronze construction. Provide heads with nominal ½" discharge orifice except where greater than normal density requires large orifice.

C. Provide ordinary-temperature sprinklers except where maximum ceiling temperatures exceed 100°F such as at skylights, sealed display windows, unventilated attics and roof spaces, over cooking equipment, adjacent to diffusers, unit heaters, uninsulated heating pipes or ducts, boiler rooms, or where otherwise indicated. Where maximum ceiling temperatures exceed 100°F, provide sprinklers with temperature ratings in accordance with NFPA 13 standards.

D. See drawings schedules sheet(s) for more information of specified sprinkler head types, colors and finishes.

2.13 SPRINKLER HEAD COVERS

A. Sprinklers shall be as manufactured by TYCO, Grinnell, Reliable, Viking or Victaulic,

B. See drawings fire sprinkler head and design hazard schedule for more information of specified heads, colors and finishes.

2.14 SPRINKLER HEAD GUARDS

A. Sprinklers shall be as manufactured by SprinkGuard, TYCO, Grinnell, Reliable, Viking or Victaulic,

B. See drawings fire sprinkler head and design hazard schedule for more information of specified heads.

2.15 SPRINKLER HEAD CONNECTORS / DROPS

A. Sprinkler head connectors / drops shall flexible and be equal to Victaulic series AQB braided Aquaflex stainless steel sprinkler fitting with 1-BEE bracket for connection to ceiling grid system. Minimum size shall be 1".

2.16 IDENTIFICATION

A. Valve Tags: Identify each valve in the system with valve tags in conformity with the Fire Underwriters and State of Wisconsin requirements. Round brass tags with ½ inch numbers, ¼ inch system identification abbreviation, 1 ¼ inch minimum diameter with brass jack chains or brass "S" hooks around the valve stem, available from EMED Co., Seton Name Plate Company or W.H. Brady.

B. Chart: Furnish three (3) charts, listing all valves, giving them locations in the building and their function in the system. One (1) chart with glass cover and neat frame; two (2) charts without frames to be delivered to the Architect.

C. All piping and equipment in this Division of the Work shall be identified as required by NFPA Codes and local Fire Department Standards with not less than 1 inch high letters/numbers for marking pipe and equipment.

D. Engraved Name Plates: White letters on a black background, 1/16 inch thick plastic laminate, beveled edges, screw mounting, Setonply Style 2060 by Seton Name Plate Company or Emedolite Style EIP by EMED Co., on equal, by W.H. Brady.

PART 3 - EXECUTION

3.1 ERECTION

A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of fire protection piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, ceiling grid layout, light fixtures, and grilles before installing piping.

B. Install piping so that system can be drained. Where possible, slope to main drain valve. Slope dry pipe or pre-action systems subject to freezing at minimum ¼"/10' on mains and ½"/10' on branches. Where piping is susceptible to freezing and cannot be fully drained, install nipple and cap for drainage of less than 5 gallons or valve/nipple/cap for drainage over 5 gallons. Pipe drain valves to grade or to air gap sewer receptor.

3.2 JOINTS AND CONNECTIONS

A. Threaded Pipe Joints: Use a thread lubricant or Teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

B. Mechanical Grooved Pipe Connections: Use pipe factory grooved in accordance with the coupling manufacturer's specifications or field grooved pipe in accordance with the same specifications using specially designed tools available for the application. Lubricate pipe and coupling gasket, align pipe, and secure joint in accordance with the coupling manufacturer's applications.

C. Copper Piping Joints: Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe surfaces. Clean fitting and tube with metal brush, emery cloth or sandpaper. Remove residue from the cleaning operation, apply flux and assemble joint to socket stop. Apply flame to fitting until solder melts when placed at joint. Remove flame and feed solder into joint until full penetration of cup and ring of solder appears. Wipe excess solder and flux from joint.

3.3 HANGERS AND SUPPORTS

A. Installation: Install supports to provide for free expansion of the piping system. Support all piping from the structure using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. Fasten ceiling plates and wall brackets securely to the structure and test to demonstrate the adequacy of the fastening.

3.4 SPRINKLER HEADS

A. Locate sprinkler heads as indicated on fire protection plan and reflected ceiling plan maintaining minimum clearances from obstructions, ceilings, and walls. Install sprinkler heads level in location not subject to spray pattern interference. Center sprinkler heads in ceiling panels.

B. Sprinkler heads with concealed covers shall match the adjacent ceiling with color. Sprinkler heads with concealed covers shall have its color matched / painted by the manufacturer.

3.5 SWITCHES

A. Locate flow and pressure switches where indicated and where required to obtain specified zoning to isolate floors and major areas of floors. Provide valved test connection for flow switch adjacent to flow switch. Pipe to floor drain. Test flow switch to verify proper operation.

3.6 GAUGES

A. Provide a valved pressure gauge in main fire sprinkler zone riser.

3.7 VALVES

A. Properly align piping before installation of valves. Do not support weight of piping system on valve ends. Mount valves in locations which allow access for operation, servicing, and replacement. Install all valves with the stem in the upright or horizontal position. Valves installed with the stems down will not be accepted. Provide a riser shutoff valve and a capped hose thread drain valve at the bottom of each riser. Provide capped hose thread drain valves to allow draining of each portion of piping.

3.8 IDENTIFICATION

A. All equipment, pipe and valves, etc., shall be identified as listed below.

B. All piping in this Division of the Work exposed, in access spaces or above ceilings shall be identified at minimum of 25’ intervals and at least once in every room with W.H. Brady Co., Seton, or equal, pipe marking labels, 2¼” color as required by A.N.S.I. standards.

C. Sprayed on pipe stencils letterings are not allowed.

D. Valve tags shall be 1 1/8” round brass tags with black numerals. Fasten tags to body of valves with copper or brass chain. Numerals on tags shall correspond to the record drawings.

E. Charts:

1. Furnish three (3) charts listing all valves, giving their location in the building and describing the valve number, service, function, normal position, etc. One (1) chart encased in plastic to be mounted in the building maintenance office and the other two (2) charts delivered to the Architect for transmittal to the Owner.
2. Furnish one (1) overall floor plan showing the location of all valves and the corresponding number from the valve chart.
3. Provide hydraulic design information sign of permanently marked weatherproof metal or engraved nameplate material Secure to alarm valve with brass chain. Information to include location of the design areas, discharge densities, required flow and residual pressure at the base of riser, hose stream demand and sprinkler demand.

3.9 FIELD MEASUREMENTS

A. Field verify all measurements. Do not base on contract drawings.

B. Identify conflicts with the work of other trades prior to installation of work.

C. Adjust system to satisfy field requirements.

3.10 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Maintain original quality and condition of equipment while it is in storage.

3.11 INSTALLATION

A. General

1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer's recommendations.
2. Install all materials, assemblies, fixtures and equipment in strict accordance with manufacturer's recommendations and instructions. Consult manufacturer for all diagrams, schematics, sizes, outlets, etc. before installing.

B. Painting

1. Exposed piping is to be painted by Painting Contractor. This Division Contractor shall protect sprinkler heads and equipment from painting in exposed areas.

C. General

1. See specifications section 21 05 00 – Fire Suppression Requirements for more information.

D. Testing

1. All testing that is required for the installation of the system specified shall be done by this Division's contractor prior to painting, backfilling, installation of pipe covering, or concealment within the building construction.
2. All tests shall be conducted in the presence of and to the satisfaction of the inspector having jurisdiction.
3. Testing shall be conducted in accordance with the Wisconsin Building Code and NFPA standards or as hereinafter specified.
4. Repair any leaks that occur during testing, and retested until no leaks occur for the installation of the system specified shall be done by this Division's contractor.
5. The system specified shall be tested and proved watertight under a water pressure not less than 200 PSI for a period of two hours. Where system design is in excess of 150 psig, test at a pressure 50 psig above system design pressure.
6. All pressure tests are to be documented on NFPA Contractor's Material and Test Certificate forms.

3.12 OWNER TRAINING

A. Instruct Owner's personnel in the proper operation, maintenance and testing of systems and equipment provided as part of this project.

3.13 SPARE EQUIPMENT

A. Provide quantity of spare heads as noted below and 1 wrench for each type of head and each temperature range installed. Provide 6 spare heads per 300 or less installed heads, 12 per 1000 or less and 24 for more than 1000. Provide steel cabinet for storage of heads and wrenches.

END OF SECTION 211000

SECTION 220500 - PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work under this Section.

B. This Section applies to all Division 22 sections of plumbing.

C. The Contractor preforming the work of this Section applies to the plumber and or pipe fitter licensed and certified per the State of Wisconsin requirements.

1.2 APPLICABLE PUBLICATIONS

A. Publications, standards and listing requirements called out in the Sections of this Division of Labor shall form a part of these specifications as if contained herein.

B. The requirements of the Contract Documents, including the General Conditions, and Supplementary Conditions, and Division 01 - General Requirements, apply to this section except as modified herein.

1.3 DESCRIPTION OF WORK

A. Requirements of Instructions to Bidders, General and Project Requirements apply to work under this Division, which shall include:

1. Section 22 05 00 – Plumbing Requirements
2. Section 22 05 05 – Through-Penetration Firestopping
3. Section 22 07 00 – Plumbing Insulation
4. Section 22 11 00 – Domestic Water Distribution System
5. Section 22 12 00 – Sanitary Drain, Waste and Vent System
6. Section 22 13 00 – Storm and Clear Water Drain, Waste and Vent System
7. Section 22 14 00 – Natural Fuel Gas Distribution System
8. Section 22 15 00 – Compressed Air Distribution System
9. Section 22 30 00 – Plumbing Equipment
10. Section 22 40 00 – Plumbing Fixtures

B. Work Included:

1. The work covered by this Division of the specifications includes the furnishing of all labor, materials, tools, equipment, permits, certificates and temporary connection necessary for or incidental to executing and completing the plumbing work to make the system ready for normal and proper operation, including all work or materials not directly shown on the drawings or in the specifications, but necessary for the proper operation of the system.

2. All work shall be as specified and indicated on the drawings unless specifically excepted on the drawings or herein and in compliance with the State of Wisconsin Uniform Building and Plumbing Code , Local Codes and Ordinances, Local Utility Regulations and OSHA.
3. All work shall be performed by individuals' license and certified per the State of Wisconsin requirements. Their work shall be performed to the satisfaction of the Architect / Engineer, and Owner.
4. Read all other Divisions of the Specifications which are applicable to this work, including the General Conditions section applicable to all bidders.
5. This section is a supplement to and not a replacement for the project General Condition's section.
6. In cases of conflict with information in the General Conditions, the more stringent of the contract requirements shall be considered applicable.
7. Prior to submitting bid, call to the attention of the Engineer any material or apparatus believed to be inadequate or any necessary items or work omitted.
8. Address any questions regarding the interpretation of the plans and/or specifications at least 12 days before the bid opening.
9. The Engineer reserves the right to interpret his own specifications and plans after bids are received, and to demand that the installation conform to his intent.
10. All piping is to be concealed. If building construction does not permit the concealing of piping, locations and routing are to be approved by Architect / Engineer prior to installation. Route piping in structural webbing of floor/ceiling joist in areas where piping is exposed. It is the responsibility of the contractor to verify the routing of all piping, devices, fixtures and equipment with other trades.
11. Field verify underground piping location, depth and size at point of connection and that new pipe route is clear of utilities and other obstructions prior to Installation of any underground piping. Costs Incurred for failure to do so shall be the Contractor's responsibility.
12. No work shall be completed and no prefabrication started until Architect / Engineer has reviewed and approved shop drawings and coordinated pipe routing with other trades.

C. Examination of Plans, Specifications and Site:

1. Before submitting a bid, the bidder shall familiarize himself with all features of the building and site which may affect the execution of his work.
2. No extra payment will be allowed for the failure to obtain this information.
3. If there are omissions or errors in the plans or specifications, they shall be clarified with the architect prior to submitting bid.

D. Codes, Permits, and Inspection Fees

1. All work and materials shall conform in every respect to the current rules and requirements of the State of Wisconsin Uniform Building and Plumbing Code, Local Codes and Ordinances, Local Utility Regulations and OSHA.
2. Give to the proper authorities all required notices relating to the project, obtain all official permits and licenses required, pay all fees incidental thereto, deliver upon completion of the work and without cost to the Owner all required certificates of inspection and approval.
3. Secure all local permits, utility fees and licenses applicable for the work under this Division and pay all fees, including posting all bonds incidental thereto. Plan review

submittal to the State of Wisconsin Department of Safety and Professional Services or its designated municipality, shall be by the Architect and Engineer.

1.4 RELATED WORK ELSEWHERE

A. Thoroughly inspect entire set of plans and specifications as to the class of building construction in general and specifically to the items of other divisions that affect the work of this Division.

B. Work of this Division also includes any plumbing work shown on the drawings and included in the specifications of other Divisions.

C. Drawings and specifications of the work under this Division are intended for a complete project. If trade jurisdiction requires portions of the work be done by other tradesmen, this Division's contractor shall sublet those portions of the work to qualified contractors, however this Division's contractor shall be held fully responsible for all such installations.

1.5 SHOP DRAWINGS

A. Submit shop drawings for all fixtures, equipment and systems as indicated in the specification. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of manufacture's name and/or number, as indicated in the contract documents.

B. Submit electronic files with dimensions, capacities, and information as soon as available from the list of acceptable manufacturers.

C. Shop drawings shall include, but are not limited to, the following items:

1. Plumbing Fixtures and Trim.
2. Plumbing Equipment and Accessories.
3. Drains and Cleanouts.
4. Backflow Preventers.
5. Pipe, Fittings, and Valves.
6. Bedding and Backfill Material.
7. Pipe Insulation, and Pipe Hangers / Support.
8. Pipe Labels, and Valve Tags.

D. The Architect, Engineer or its representative shall review and comments on all items being submitted and items to be installed. The Architect, Engineer or its representative holds the right to request submitted items to be revised and resubmitted or to reject a submitted item if it does not meet the conformity with the design concept of the work as established in the Contract Documents.

E. All shop drawings, product data, and samples submittals shall illustrate details of the work, fixtures, equipment, materials, products, systems, designs or workmanship that this Division's contractor intends to use in order to comply with the design concept established in the Contract Documents. Review of these submittals by the Architect, Engineer or its representative is only for the limited purpose of checking for conformity with the design concept of the work as established in the Contract Documents, and is not intended to be for the purpose of determining the accuracy of other matters that may be contained in such submittals, including, but not

limited to such matters as dimensions, quantities, performance of fixtures, equipment and systems design and installed, engineering and design, construction means, methods, techniques, sequences, procedures or safety precautions, the correctness of which as set forth in the Contract Documents or submittal shall be the sole responsibility of by this Division's contractor.

F. Any flagged deviations on the shop drawings from the specified item and any approval of the shop drawings will not be considered acceptance of the deviation unless it's been explicitly flagged.

G. Where any specific fixture, equipment, materials, process or method of construction is specified by name or by reference to the model number of a manufacturer, the specifications are to be used as a guide and are not intended to take precedence over the basic duty and performance specified or noted on the drawings.

1.6 OPERATION & MAINTENANCE MANUALS

A. Submit operation and maintenance manuals following Section specific shop drawing submittal guidelines.

1. Upon the complete installation of the work under this Division, this Division's contractor shall provide the necessary qualified personnel for operating the systems as directed by and scheduled with the Architect, Engineer and the Owner. At this time, this Division's contractor shall instruct the Owner or his representative in the operation, adjustment and maintenance of all equipment furnished.
2. Provide (1) electronic and three (3) paper copies of maintenance manuals shall be submitted, which shall present full details for the care, maintenance, and operation of all equipment and systems.
3. The manuals shall include operating and maintenance literature for all components provided. The submitted literature shall be in sufficient detail to allow for the installation, operation, adjustment, calibration, maintenance and removal of each component provided.
4.
5. Provide documentation in the operation and maintenance manual to required testing of the work under this Division.

B. Record Drawings:

1. Record drawings shall be kept daily, noting all changes and available upon demand.
2. Record drawings shall reflect any changes or pipe re-routing due to construction phasing or existing field conditions.
3. Final record drawings shall be provided to Architect / Engineer and owner at the completion of the project. Final record drawing shall be submitted in electronic PDF form (not hand written mark-ups) or recorded in CAD / BIM format with the ability to extract an electric PDF.

1.7 QUALITY ASSURANCE

A. All products and materials used are to be new, undamaged, clean and in good condition. Existing products and materials are not to be reused unless specifically indicated.

B. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings or engineering parameters from those indicated on the contract documents, the Contractor is responsible for all costs involved in integrating the equipment or accessories into the system and for obtaining the intended performance from the system into which these items are placed.

C. Provide all necessary accessories required for a complete and operable system.

1.8 WARRANTY

A. The Work of this Division shall be guaranteed, in writing, to be free from defects in materials and/or workmanship for one (1) year from the date of certificate of completion and acceptance of the work. Necessary instruction and/or emergency services to be performed as a result of defects in materials or workmanship shall be furnished for one (1) year at no extra cost for labor or materials. If default thereof, the Owner may have such work done and charge all applicable costs to the Contractor.

B. Furnish manufacturer's written warranties on all equipment to the Owner stating effective date of warranty.

C. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

PART 2 - PRODUCTS

2.1 GENERAL

A. It is the intent of these specifications that all the necessary material, apparatus, and devices to complete the installation as specified herein, except such parts as are specifically accepted, shall be provided.

B. If an item is either shown on the drawings or called for in these specifications, shall be considered sufficient as an item part of this contract.

C. All materials, products, fixtures and equipment shall be an approved product per the State of Wisconsin Department of Safety and Professional Services.

D. All sizes given are as minimum.

E. Material and labor shall be first class and workmanlike and to the satisfaction of the Plumbing Engineer and shall be subject to inspection test and approval at all times from commencement until acceptance of completed work.

F. Manufacturers shall be responsible for providing material listed by U.L. or other approved agencies, and all governing codes and ordinances.

G. All material must bear U.L. and/or other approved labels where possible.

H. Items specified by catalog number or brand name and approval of shop drawings will not relieve the manufacturer of this responsibility.

2.2 HANGERS, ANCHORS AND INSERTS

A. See plumbing drawing's Pipe Hangers, Supports and Insulation Detail.

B. All piping in the plumbing system shall be supported with hangers in accordance with the provisions of the Wisconsin Uniform Plumbing Code.

C. The use of perforated strap hangers will not be acceptable.

D. Use approved malleable, wrought iron or steel pipe riser clamps for steel or cast iron pipes and copper plated clamps for copper pipes.

E. Provide all necessary inserts for supporting piping and equipment.

F. Piping shall be supported with clevis or adjustable band loop hangers at intervals recommended by the manufacturer.

G. Provide low compressive insulation protectors on all insulated piping supported by hangers or strut channel. Protective shield material shall be galvanized carbon steel with pre-insulated calcium silicate support blocks.

H. Manufacturers shall be as listed above, B-Line, Anvil, Fee & Mason, Elcen or an acceptable approved equal approved by the engineer. No private label wholesale products will be accepted.

2.3 SUPPORTS

A. See plumbing drawing's Pipe Hangers, Supports and Insulation Detail.

B. Provide all structural supports required for equipment included under this Division of the Work.

C. Structural supports that is required for the installation of the system specified shall be done and repaired by this Division's contractor in coordination with the general contractor and under the direction and to the satisfaction of the Architect and Engineer.

D. Manufacturers shall be as listed above, B-Line, Anvil, Fee & Mason, Elcen or an acceptable approved equal approved by the engineer. No private label wholesale products will be accepted.

2.4 ESCUTCHEONS

A. See plumbing drawing's Pipe Penetration Detail.

B. Provide on all pipes passing through finished floors, walls and ceilings with outside diameter sufficient to cover sleeve opening and inside diameter to fit snugly around pipe.

C. Escutcheon plates shall be chrome plated brass.

D. Manufacturers shall be as listed above, BrassCraft, Dearborn, Keeney, McGuire or an acceptable approved equal approved by the engineer. No private label wholesale products will be accepted.

2.5 ACCESS PANELS

A. Provide access panels with a key locking device and sized as required for the access to all cleanouts, valves, traps, thermostatic mixing valves, water hammer arresters, etc.

B. Panels shall be installed by Plumbing Contractor in openings provided by the General Contractor as located and supervised by this Division.

C. Manufacturers shall be as listed above, KARP and Associates, Milcor, Titus or an acceptable approved equal approved by the engineer. No private label wholesale products will be accepted.

2.6 IDENTIFICATION

A. All equipment, pipe and valves, etc., shall be identified as listed below.

B. All piping in this Division of the Work exposed, in access spaces or above ceilings shall be identified at minimum of 25’ intervals and at least once in every room with, pipe marking labels, 2¼” color as required by A.N.S.I. standards.

C. Sprayed on pipe stencils letterings are not allowed.

D. Valve tags shall be 1 1/8” round brass tags with black numerals. Fasten tags to body of valves with copper or brass chain. Numerals on tags shall correspond to the record drawings.

E. Equipment and starters shall be identified with neat, clear, permanent labels.

F. Valve Charts:

1. Furnish three (3) charts listing all valves, giving their location in the building and describing the valve number, service, function, normal position, etc. One (1) chart encased in plastic to be mounted in the building maintenance office and the other two (2) charts delivered to the Architect for transmittal to the Owner.
2. Furnish one (1) overall floor plan showing the location of all valves and the corresponding number from the valve chart.

G. Manufacturers shall be W.H. Brady Co., Seton, or an acceptable approved equal approved by the engineer. No private label wholesale products will be accepted.

2.7 PIPE SLEEVES AND PENETRATIONS

A. See plumbing drawing’s Pipe Penetration Detail.

B. Pipe sleeves and penetrations passing through fire walls, barriers, floors or ceilings shall be sealed with fire barrier caulking. 3-M Fire Barrier CP-25 caulk and 303 putty synthetic elastomers, U.L. rated.

C. Provide sleeves for pipes passing through masonry or concrete tunnels, basins equipment, walls and floors, seal all openings between pipe and sleeve with vinyl acrylic plastic.

D. Pipe sleeves passing through floors outside of chases shall be constructed of schedule 40 galvanized steel pipe ½" larger than pipe or pipe insulation and shall extend ½" above finished floors.

E. Pipe sleeves passing through walls, partitions, etc., for piping exposed to view shall be constructed of 20 gauge galvanized iron sleeves 1" larger than pipe or pipe insulation and shall extend ½" from the finished surfaces.

F. Pipe penetrations passing through masonry or concrete that are cored and below grade or subjected to water or ground water shall have its opening 1" larger than the outside diameter of the penetrating pipe and sealed with a mechanical link-seal. Locations shall include, but not limited to, tunnels, equipment basins, walls and floors.

G. Manufacturers for fire barriers shall be U.L. listed 3-M Fire Barrier CP-25 caulk, 303 putty synthetic elastomers or an acceptable approved equal approved by the engineer.

H. Manufacturers for mechanical link-seals shall be Garlock, Trumbul, or an acceptable approved equal approved by the engineer.

2.8 TEMPORARY UTILITIES AND TOILETS

A. Water:

1. Temporary water shall be provided by this Division's contractor.
2. Temporary water piping shall be provided with protection from freezing
3. Provide two (3) ¾" hose bibbs with backflow protection located where directed for use by all Contractors.
4. This Division's contractor shall maintain valves and connections in perfect condition at all times. Each trade contractor shall provide their own hose or piping from hose bibbs provided by this Division's contractor.
5. Each trade contractor shall be mindful as to prevent the waste of water used for their work.
6. The Owner will pay the cost of cold water used only. Contractors requiring hot water for construction use shall make their own provisions.

B. Toilet:

1. The General Contractor shall provide approved and adequate temporary toilet facilities for all trades.

C. Pumps:

1. Temporary pumps required for pumping water from building and excavations shall be provided by the contractor providing the work.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify fixtures and equipment are in compliance with approved submittal drawings.

3.2 FIELD MEASUREMENTS

A. Field verify all measurements. Do not base on drawings.

B. Identify conflicts with the work of other trades prior to installation of work.

C. Adjust system to satisfy field requirements.

3.3 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Maintain original quality and condition of equipment while it is in storage.

3.4 INSTALLATION

A. General:

1. The complete installation of the work under this Division shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer's recommendations.
2. Install all materials, assemblies, fixtures and equipment in per the manufacturer's recommendations and requirements. Consult manufacturer as required for missing information and technical advice of that product.
3. All equipment, tools, pipe, fittings and valves required for construction, phases of construction, and the "means and methods" of construction shall be provided this Division's contractor.
4. Exposed piping is to be painted by Painting Contractor. This Division Contractor shall protect fixtures and equipment from painting in exposed areas.

B. Electrical Coordination

1. Electrical Contractor will furnished and install all power wiring to control panels, valves, aquastats, low voltage transformer box, fixtures, equipment and other devices furnished by this Division's contractor that is required for the operation of the plumbing system.
2. Provide manufacturer's wiring diagrams to Electrical Contractor for all equipment and devices furnished by this Division's contractor and as indicated to be wired by the Electrical Contractor.

C. Piping:

1. All installation to be installed per the local and state codes.

2. Provide a pressure reducing valve immediately downstream of the domestic water meter and by-pass piping for incoming water pressure that exceed 80psig.
3. Provide isolation ball valves and balancing valves to isolate cold water, hot water supply and hot water return branch piping from its cold water, hot water supply and hot water return main piping for each plumbing fixture or rooms with multiple plumbing fixtures.
4. Provide isolation valves on all cold water and hot water supply branch piping off of the main hot water supply main piping.
5. Provide balancing valves on all hot water return branch piping off of the main hot water supply main piping.
6. All horizontal piping shall be installed level unless otherwise noted.
7. All vertical piping shall be installed plumb.
8. Avoid locating any piping over electrical equipment or in elevator equipment rooms.
9. All valves and valve handles shall be installed in an accessible location. Valve handles shall operate so that pulling down will close the valve. Provide adequate spacing between piping for proper operation of valves and for service and maintenance.
10. Conceal all piping whenever possible. Bring stub extensions as close to fixtures as possible. Install all piping so that it can be drained, and provide a brass drain plug at low points and at the bottom of risers.
11. All thermometers and pressure gauges shall be located so they can be viewed from the floor and in the upright position.
12. Domestic hot water and hot water return system shall run us at a maximum velocity of 5 feet per second for heat maintenance. Provide balancing valve downstream of pump per design required flow per equipment schedule.
13. Provide additional balancing valves in the piping system as required to maintain the design required flow and maximum velocity. Where domestic hot water return branch piping connect to the main domestic hot water return loop, a balancing valve shall be installed on the branch pipe.
14. After the water heater(s) and circulating pump(s) are placed in operation, the Plumbing Contractor shall balance the domestic hot water distribution system. Balancing valves shall be balanced with approved tools, such as a manometer to calibrate proper flow. The final balancing of the domestic hot water distribution system shall provide hot water within 5 seconds at the most remote plumbing fixture when operated after 1 hour of non-operation.
15. Route hot water return piping within two feet of the plumbing fixtures used for hand washing in accordance with IECC C404.5.1.
16. Provide each balancing valve with a check valve, union and ball valve on the upstream side, unless balancing valve contain these items as integral parts.
17. Plastic Piping:

    a. Installation of plastic piping through fire rated walls and ceilings must comply with the standards of the Wisconsin Administrative Code. Plastic piping may not be installed in fire rated walls or ceiling plenums except as noted in paragraph 18.
    b. Tremco Brand Fire Barrier Penetration Sealing Systems may be used where plastic piping penetrates fire rated walls and floors. Sealants shall be installed per manufacturer's recommendations and by trade's people familiar with the products. Approval of the local authorities must be obtained before any installation of this product is accepted.

18. Piping within A Plenum Ceiling:

a. Plumbing within the plenum ceiling shall be of non-combustible material or shall have a flame spread index of not more than 25 and a smoke−developed index of not more than 50 when tested in accordance with ASTM E84, CAN/ULC S102.2 or UL 723 with the exception of combustible materials fully enclosed within continuous noncombustible raceways or enclosures, or within materials listed and labeled for such application.

D. Excavation:

1. Excavating and backfill as defined in Section [31 23 00] takes precedence over statements made in this section should any conflicts occur.
2. Contact public utilities and the building's maintenance personnel to determine locations of their underground installations and avoid confliction therewith. Underpin and support all lines. Cut off service connections encountered which are to be removed at the limits of fire excavation and cap. In the event relocation of plumbing utility services is necessary to avoid this conflict, the Architect and Engineer shall be consulted.
3. Make all necessary excavations for plumbing utility services, system piping and equipment. Excavate to bottom of pipe and structure bedding, 4" in stable soils 6" in rock or wet trenches and 8" in unstable soil. Finish bottoms of excavations to true, level surface.
4. At no time place excavated materials where it will impede surface drainage unless such drainage is being safely rerouted away from the excavation or work of other trades.
5. Underground piping shall be laid on 4" of bedding sand or pea gravel to support pipe evenly and avoid hubs supporting piping. All installations shall be constructed in an approved manner to the complete satisfaction of the Engineer.
6. Underground plastic pipe and tubing shall be installed in accordance with ASTM D2774.
7. Excavate whatever materials are encountered as required to place at the elevations as shown on drawings. Remove debris and rubbish from excavations before placing bedding and backfill material.
8. Provide and maintain all fencing, barricades, signs, warning lights, and/or other equipment as required around all excavation areas at all times. No excavation shall be left unattended without adequate protection.
9. Elevations shown on the plans are subject to such revisions as may be required to fit field conditions.
10. Install piping passing under foundations with minimum of 1 ½" clearance to concrete and insure there is no disturbance of bearing soil. Care must be taken in excavation that the walls and footings will not be disturbed in any way.
11. Excavated materials from areas under building construction shall be removed from the site unless otherwise noted.
12. Bedding:

    a. Bedding material shall be thoroughly compacted sand, peal gravel or 3/8" crushed stone chips.
    b. Bedding material depth shall be a minimum of 4" from the bottom of excavated trench to bottom of pipe.
    c. Bedding material shall extend up from the bottom of the pipe to the pipe's centers spring-line.
    d. Verify will pipe manufacturer's recommendation and requirements.
    e. See ASTM D2321 Standard Practice for underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications for more information.

13. Backfill:

    a. Initial backfill material shall be thoroughly compacted sand, peal gravel or 3/8" crushed stone chips.
    b. Initial backfill material depth shall be a minimum from the pipe's centers spring-line to 8" above the top of the pipe.
    c. Final Backfill shall be clean crushed bank run sand or peal gravel, gravel or soil / dirt is acceptable above the initial backfill requirements. Place final backfill in layers not more than 8" in loose depth, compacting each layer to required maximum density. Do not place final backfill material on surfaces that are muddy, frozen, or contain ice or frost. All final backfill materials shall be vibrator compacted.
    d. Place and compact acceptable final backfill materials in layers to required elevations. Final backfill materials shall be free of clay, rock debris, vegetable matter, waste and frozen materials. Use sub-base material where indicated under piping or conduit; shape to fit bottom 90 degrees of cylinder.
    e. Verify will pipe manufacturer's recommendation and requirements.
    f. See ASTM D2321 Standard Practice for underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications for more information.

14. Compaction:

    a. Compact each layer of backfill to 90% maximum density for cohesive soils and 95% relative density for cohesion less soils; at lawns or unpaved areas, 85 maximum density for cohesive soils and 90% relative density for cohesion less soils or requirements of Section 31 23 00 which takes -precedence if requirements are stricter.
    b. Perform and pay costs of field density tests in accordance with Section 31 23 00 of the specifications.

15. Surface Restoration:

    a. Completely restore the surface of all disturbed areas to a like condition of the surface prior to the work. Level off and clean up all areas used for the storage of materials or the temporary deposit of excavated earth. Remove all surplus material, tools and equipment. Replacement of all existing areas removed to install piping by Plumbing Contractor must be replaced to match existing.

16. Sheeting, Shoring and Bracing:

    a. Provide shoring, sheet piling and bracing in conformance with the Wisconsin Administrative Code to prevent earth from caving or washing into the excavated earth. Shore and underpin to properly support adjacent or adjoining structures. Abandon in place shoring, sheet piling and underpinning below the top of the pipe, or if approved, in advance by the engineer, maintained in place until other permanent support approved by the engineer is provided.

17. Dewatering:

a. Provide, operate and maintain all pumps and other equipment necessary to drain and keep all excavation pits, trenches and the entire subgrade area free from water under all circumstances.

18. Rock Excavation:

a. Remove rock encountered in the excavation to a minimum density of six (6) inches outside the pipe. Rock excavation includes all hard, solid rock in ledges, bedded deposits and unstratified masses, all natural conglomerate deposits so firmly contented as to present all the characteristics of solid rock; which material is so hard or so firmly cemented that in the opinion of the Engineer it is not practical to excavate and remove same with a power shovel except after thorough and continuous drilling and blasting. Rock excavation includes rock boulders of 2 cubic yard or more in volume.

b. Rock excavation will be computed on the basis of the depth of rock removed and a trench width two (2) feet larger than the outside diameter of the pipe where one (1) pipe is laid in the trench and three (3) feet larger than the combined outside diameter where two (2) pipes are laid in the trench. Include 6" pipe and structure bedding in rock excavation. Include rock excavation shown on the plans in the Base bid.

E. Diagrams, Measurements, Final Layout Drawings:

1. Drawings show the layout in general and approximate locations of piping, major equipment, etc., and shall be followed as closely as the actual construction of the building, work of other trades, and the locations of equipment will permit.
2. All changes from the drawings necessary to make the work under this Division conform to the building as constructed and to fit the work of other trades shall be made without extra cost.
3. Drawings for the work under this Division shall not be scaled for exact dimensions. Consult the architectural and structural drawings and details for all dimensions and location of the work under this Division.

F. Protection of Finished Work and Materials:

1. Protect all materials and work performed under this Division from damage or injury that may be caused by other workmen and from the action of the elements.
2. Protect the materials and work performed by other Divisions, and the Owner's property from damage or injury arising from work under this Division.
3. Keep all piping and equipment capped, plugged, drained, or otherwise protected including protection from freezing and by stoppage from building materials, sand or dirt, mortar, concrete, etc.

G. Painting

1. Exposed piping is to be painted by Painting Contractor. This Division Contractor shall protect fixtures and equipment from painting in exposed areas.

H. Cleaning and Finishing:

1. After all work under this Division have been made and the system pronounced as satisfactory, this Division's contractor shall go over all his work and clean equipment, fixtures, piping, etc. and leave clean and in complete working order at final completion of the building.
2. The putting of new work, or any part thereof, into use, even though with the Owner's consent, shall not be construed to be an acceptance of the work on the part of the Owner, nor shall it be construed to obligate him, in any way, to accept improper work or defective material.

I. Cooperation with Other Divisions and the Owner:

1. Give full cooperation to other trades and furnish any information necessary to permit the work of all trades to be installed satisfactorily and with least possible interference or delay.
2. The Work of this Division must be coordinated with the work of other Divisions and the Owner to prevent interference. Any necessary changes to be made because of the lack of proper coordination shall be performed without extra charge.
3. Where the work of this Division will be installed in close proximity to the work of other trades, or where there is evidence that the work of this Division's contractor will interfere with work of other trades, they shall assist in working out space conditions to make a satisfactory adjustment.
4. Coordinate work of this Division so the installation of the piping and supports do not conflict with electrical code required clearances or in elevator hoist ways or equipment rooms. Plumbing systems are shown to be approximate on plans. Exact locations of equipment must be coordinated by this Division's contractor with other trades prior to installation.
5. Provide manufacturer's wiring diagrams to Electrical Contractor for all equipment and devices furnished by this Division's contractor and as indicated to be wired by the Electrical Contractor.
6. Electrical Contractor will furnish and install all power wiring to control panels, valves, fixtures, equipment and other devices furnished by this Division's contractor that is required for the operation of the plumbing system.
7. If this Division's contractor installs their work before coordinating it with other trades, they shall make necessary changes in their work to correct the condition without extra charge.
8. Provide all service connections under the jurisdiction of the work under this Division to Owner's equipment or equipment furnished by other Divisions as required for a complete and operating installation.

J. Supervision:

1. Provide the services of an experienced superintendent who shall be constantly in charge of all the work included in or related to this Division.

K. Substitutions:

1. All costs, as a result of submitted substituted items by the Contractor and with the approval by the Architect or Engineer, including costs required under other Contracts, shall be the responsibility of the Contractor requesting the substitution. None of the extra costs resulting from such approval shall evolve upon the Owner, the Architect, other Consultants, or other Contractors.

3.5 OWNER TRAINING

A. Provide as outlined in each specification section requiring owner training.

3.6 SPARE EQUIPMENT (NONE)

END OF SECTION 220500

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SECTION 220505 - THROUGH-PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

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

1.2 APPLICABLE PUBLICATIONS

A. Fire Test Requirements

1. ASTM E-814, “Fire Tests of Through Penetration Fire Stops”.
2. ANSI/ UL1479, “Fire Tests of Through Penetration Fire Stops”
3. ASTM E-119, “Fire Tests of Building Construction and Materials”.
4. ANSI/ UL263, “Fire Tests of Building Construction and Materials”.
5. ASTM E-84, “Surface Burning Characteristics of Building Materials”.
6. ANSI/ UL723, “Surface Burning Characteristics of Building Materials”.

B. References

1. Underwriters Laboratories (UL) of Northbrook, IL “Fire Resistance Directory”.

   a. Through Penetration Firestop Systems (XHEZ)
   b. Fill, Void or Cavity Materials (XHHW)
   c. Firestop Devices (XHJI)
   d. Forming Materials (XHKU)

2. All major building codes:

   a. International Building Code published by ICC.

3. National Fire Protection Association (NFPA) of Quincy, MA “NFPA 101: Life Safety Code”.

1.3 DESCRIPTION OF WORK

A. Furnish and install a complete firestopping installation as specified herein.

B. This section includes through-penetration firestop systems for the plumbing system’s fixtures, equipment and piping penetrations through the following fire-resistance rated assemblies, including both blank openings and openings containing penetrating items:

1. Floor-ceiling assemblies.
2. Roof-ceiling assemblies.

3. Walls and partitions.
4. Smoke barriers.
5. Construction enclosing compartmentalized areas.

1.4 RELATED WORK ELSEWHERE

A. Division 03 – Concrete

B. Division 04 – Masonry Work

C. Division 09 – Finishes

D. Division 13 – Special construction

E. Division 21 – Fire Suppression

F. Division 22 – Plumbing

G. Division 23 – Heating, Ventilation and Air Conditioning

1.5 SHOP DRAWINGS

A. Product Data: For each type of through-penetration firestop system product indicated.

B. System Drawings: Submit documentation from a qualified third-party testing agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.

C. Product Certificates: Certificate of conformance signed by manufacturers of through-penetration firestop system products certifying that products comply with requirements.

1.6 OPERATION & MAINTENANCE MANUALS (NONE)

1.7 QUALITY ASSURANCE

A. Provide through-penetration firestop systems that comply with the following requirements:

1. Firestopping tests are performed by a qualified, testing and inspection agency. A qualified testing and inspection agency is UL, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
2. Through-penetration firestop system products bear classification marking of qualified testing and inspection agency.
3. Engage an experienced installer who is certified, licensed or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install firestop products per specified requirements. A manufacturer's willingness to sell its through-penetration firestop system products to Contractor or to an installer engaged by Contractor does not in itself confer qualifications on buyer.

B. Obtain through-penetration firestop systems for each type of penetration and construction condition indicated from a single manufacturer.

C. Through-penetration firestop systems shall be subjected to necessary inspections and tests.

D. Keep areas of work accessible until inspection by authorities having jurisdiction.

E. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

1.8 WARRANTY

A. Equipment shall be warranted for a period of not less than 1 year from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

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.

PART 2 - PRODUCTS

2.1 FIRESTOPPING, GENERAL

A. Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Provide components for each through-penetration firestop system that are needed to install fill materials. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

C. Performance Requirements

1. Provide products that upon curing do not re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during and after construction.
2. Openings within walls and floors designed to accommodate cabling systems subjected to frequent cable changes shall be provided with re-enterable products specifically designed for retrofit.

2.2 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with through-penetration firestop systems (XHEZ) listed in Volume 2 of the UL Fire Resistance Directory, provide products of the following manufacturers as identified below:

1. Manufacturers listed in the UL Fire Resistance Directory – Volume 2.

2.3 MATERIALS

A. General: Use only through-penetration firestop system products that have been tested for specific fire-resistance-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.

B. Latex Sealants: Single component latex formulations that upon cure do not re-emulsify during exposure to moisture.

C. Firestop Devices: Factory-assembled steel collars lined with intumescent material sized to fit specific outside diameter of penetrating item.

D. Firestop Putty: Intumescent, non-hardening, water resistant putties containing no solvents, inorganic fibers or silicone compounds.

E. Firestop Putty Pads: Intumescent, non-hardening putty pads to be installed on metallic and nonmetallic electrical switch and receptacle boxes to reduce horizontal separation between boxes to less than 24”.

F. Wrap Strips: Single component intumescent elastomeric strips faced on both sides with a plastic film.

G. Firestop Pillows: Re-enterable, non-curing, mineral fiber core encapsulated with an intumescent coating contained in a flame retardant poly bag.

H. Mortar: Portland cement based dry-mix product formulated for mixing with water at Project site to form a non-shrinking, water-resistant, homogenous mortar.

I. Silicone Sealants: Moisture curing, single component, silicone elastomeric sealant for horizontal surfaces (pourable or nonsag) or vertical surface (nonsag).

J. Silicone Foam: Multicomponent, silicone-based liquid elastomers, that when mixed, expand and cure in place to produce a flexible, non-shrinking foam.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.

B. Do not proceed until unsatisfactory conditions have been corrected.

3.2 FIELD MEASUREMENTS

A. Verify that field measurements are as shown on Drawings.

3.3 DELIVERY STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Accept equipment on site. Inspect for damage.

C. Protect equipment from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

D. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturer's labels identifying product and manufacturer, date of manufacture; lot number; shelf life, if applicable; qualified testing and inspection agency's classification marking; and mixing instructions for multicomponent materials.

E. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants or other causes.

3.4 INSTALLATION

A. General Requirements: Install through-penetration firestop systems in accordance with "Performance Criteria" Article and in accordance with the conditions of testing and classification as specified in the published design.

B. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration firestop systems products.

1. Seal all openings or voids made by penetrations to ensure an air and water resistant seal.
2. Protect materials from damage on surfaces subjected to traffic.

C. Remove equipment, materials and debris, leaving area in undamaged, clean condition.

D. Clean all surfaces adjacent to sealed openings to be free of excess through-penetration firestop system materials and soiling as work progresses.

E. Project conditions

1. Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limitations recommended by manufacturer.
2. Do not install through-penetration firestop systems when substrates are wet due to rain, frost, condensation, or other causes.
3. Do not use materials that contain flammable solvents.

4. Do not install water-based or products that are conductive when wet in contact with energized electrical conductors. Exercise care when energizing penetrants.

F. Coordination

1. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
2. Coordinate sizing of sleeves, openings, core-drilled holes or cut openings to accommodate through-penetration firestop systems.
3. Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.

G. Preparation

1. Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellents, and any other substances that may inhibit optimum adhesion.
2. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
3. Do not proceed until unsatisfactory conditions have been corrected.

3.5 OWNER TRAINING (NONE)

3.6 SPARE EQUIPMENT (NONE)

END OF SECTION 220505

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification, apply to work under this Section.

1.2 DESCRIPTION OF WORK

A. Furnish and install a complete and operable insulation system as indicated on the drawings and as specified herein.

B. Provide and install insulation for the following:

1. Domestic – All water piping installed above the floor and below ground.
2. Sanitary – PVC drain, waste and vent piping installed in a plenum ceiling.
3. Storm – PVC primary and secondary (overflow) system’s conductors piping installed in a plenum ceiling.
4. Storm – Horizontal primary and secondary (overflow) system’s conductors piping installed above the floor.
5. Storm – Vertical primary and secondary (overflow) system’s conductors piping installed above the floor.
6. Storm – Roof drain bodies and sump pans for the primary and secondary (overflow) systems.
7. Clear Water - PVC drain, waste and vent piping installed in a plenum ceiling.

C. Quality Assurance:

1. All work shall be performed by skilled tradesmen, pipe insulator, regularly engaged in this work.
2. All spaces, equipment, piping, ductwork, etc., shall be protected from dropping of insulation materials. Leave all areas in a clean and orderly condition.
3. Insulation to have flame rating of 25 or less and shall not melt or drip when exposed to flame.
4. Insulation in active supply and return air plenums to have a smoke developed rating of 50 or less.

1.3 SHOP DRAWINGS

A. Submit electronic files of drawings with dimensions, capacities, and information as soon as available from manufacturers.

1.4 QUALITY ASSURANCE

A. All materials, equipment, and parts shall be new and unused of current manufacture.

B. Provide all necessary accessories required for a complete and operable system.

1.5 WARRANTY

A. Materials and workmanship shall be warranted for a period of not less than 1 year from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

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.

PART 2 - PRODUCTS

2.1 GENERAL

A. All products furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials and equipment shall be new (less than 1 year old when turned over to the Owner).

2.2 PRODUCTS

A. General:

1. See contract drawings and details sheet(s) for more information.
2. Insulation systems (insulation, jackets, sealants, mastics, and adhesives) that are installed in plenum ceiling shall have a flame spread rating of 25 or less and smoke developed rating of 50 or less and shall meet UL-723/ASTM E84 requirements.

B. Manufactures:

1. Pipes, fitting and valves insulation material acceptable manufactures shall be Armstrong, CertainTeed, Manville, Knauf, Owens-Corning, or an equal approved by the engineer.

C. Applications and Thickness:

1. Insulate all above ground cold water hard and soft pipes, fitting and valves with ½” thick rigid fiberglass insulation with ASJ/SSL jacket and maintain a continuous vapor barrier.
2. Insulate all above ground hot water supply and return pipes, fitting and valves with 1” thick rigid fiberglass insulation with ASJ/SSL jacket and maintain a continuous vapor barrier.

3. Insulate all storm horizontal conductor pipes, fitting and valves with 1" thick rigid fiberglass insulation with ASJ/SSL jacket and maintain a continuous vapor barrier.
4. Insulate all storm vertical conductor pipes, fitting and valves with 1" thick rigid fiberglass insulation with ASJ/SSL jacket and maintain a continuous vapor barrier.
5. Insulate all storm water roof drain sumps with 3/4" thick black flexible closed-cell elastomeric thermal insulation in sheet and roll form. Provide 520 black air-drying, solvent-based contact adhesive on a joints and seams.
6. Insulation material jointing method / adhesive shall be an approved method by the pipe insulation manufacturer.

D. PVC Jackets:

1. N/A.
2. All PVC jackets for pipe, fitting and valves shall be the color white, a minimum of 20mil at a service temperature of 0 degree Fahrenheit 180 degree Fahrenheit.

    a. Mechanical Rooms with exposed piping.
    b. Apparatus Bays with exposed piping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. See contract drawings for more information.

3.2 FIELD MEASUREMENTS

A. Field verify all measurements. Do not base on contract drawings.

B. Identify conflicts with the work of other trades prior to installation of work.

C. Adjust system to satisfy field requirements.

3.3 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Maintain original quality and condition of equipment while it is in storage.

3.4 INSTALLATION

A. General:

1. Install all products per manufacturer's specifications and recommendations.
2. See contract drawings and detail sheet(s) for more information.
3. Do not install any insulation to any piping until it has been tested and past inspection by AHJ and or Architect / Engineer.

B. Install insulation continuous without interruption through walls and floors penetrations and hangers.

C. Install insulation system on all pipes, fitting and valves as specified above. Maintain the thickness on all areas as specified above.

D. All joints shall be tight with insulation lengths tightly butted against each other.

E. All cuts shall be smooth and square and without breakage of end surfaces.

F. Adhesive shall be non-flammable solvent base, synthetic rubber type.

G. Adhesive shall be used on water and storm piping systems. Outward clinch staples may be used.

3.5 OWNER TRAINING (NONE)

3.6 SPARE EQUIPMENT (NONE)

END OF SECTION 220700

SECTION 221100 - DOMESTIC WATER DISTRIBUTION SYSTEM

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work under this Section.

1.2 DESCRIPTION OF WORK

A. Furnish and install a complete and operable system as indicated on the drawings and as specified herein.

B. Materials:

1. Materials shall conform to the standard prescribed in the Wisconsin Uniform Plumbing Code and be approved for use by the Department of Safety and Professional Services, Division of Technical Services. When required, Plumbing Contractor shall obtain approval prior to installation.
2. All materials and equipment required for the work shall be new, of first-class quality and shall be furnished, delivered, erected, connected and finished in every detail and shall be so selected and arranged as to fit into the building spaces.

C. Materials Not Included:

1. Items furnished by other Sections.

1.3 SHOP DRAWINGS

A. Submit electronic files with dimensions, capacities, and information as soon as available from manufacturers.

1.4 QUALITY ASSURANCE

A. All materials, equipment, and parts shall be new and unused of current manufacturer.

B. Provide all necessary accessories required for a complete and operable system.

1.5 WARRANTY

A. Materials and workmanship shall be warranted for a period of not less than (1) year from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

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.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacturing of such items, and for which replacement parts are available. All materials shall be new (less than 1 year old when turned over to the Owner).

2.2 MANUFACTURERS

A. Category types shall be of the same manufacturer.

B. No private label wholesale products will be accepted.

2.3 WATER SERVICE PIPING

A. All water service piping inside the building and less than 5 feet outside of the building 3 inches in diameter or larger shall meet the following minimum requirements:

1. Ductile Iron Pipe. Shall be Thickness Class 52 meeting the requirements of ANSI/AWWA C151/A21. Standard cement-mortar lining shall meet the requirements of ANSI/AWWA C104/A21.4. Pipe shall have minimum of 1 mil asphaltic outside coating in accordance with ANSI/AWWA C151/A21.51. Spotty or thin seal coating, shall be cause for rejection.

2.4 WATER SERVICE FITTINGS

A. All fittings for water services 3 inches in diameter or larger shall meet the following minimum requirements:

1. Ductile Iron Pipe. Full body fittings shall conform to ANSI/AWWA C110/ A21.10 and ANSI/AWWA C111/A21.11 with bituminous coating. Compact fittings shall conform to ANSI/AWWA C153/A21.53 and ANSI/AWWA C111/21.11 with bituminous coating. All fittings shall be provided with cement mortar lining conforming to ANSI/AWWA C104/A21.4. All DI fittings shall be manufactured in North America.
2. Polyvinyl Chloride Pipe. (Not available in 3-inch diameter) Full body fittings shall conform to ANSI/AWWA C110/ A21.10 and ANSI/AWWA C111/A21.11 with bituminous coating. Compact fittings shall conform to ANSI/AWWA C153/A21.53 and ANSI/AWWA C111/21.11 with bituminous coating. All fittings shall be provided with cement mortar lining conforming to ANSI/AWWA C104/A21.4.

3. High Density Polyethylene (HDPE). All fittings shall be molded polyethylene fused-type, PE3408, HDPE Class 160, DR11 or PE4710, HDPE Class 160, DR 13.5, DIPS and have outside diameters similar to ANSI/AWWA C151/A21.51 ductile iron pipe. Ends shall be plain for butt fuse joining.

2.5 WATER SERVICE JOINTS

A. All joints for water services 3 inches in diameter or larger shall meet the following minimum requirements:

1. Ductile Iron Pipe. Joints shall be either push-on or mechanical joint conforming to ANSI/AWWA C111/A21.11 unless specified otherwise. All joints, fittings, etc., shall be equipped to provide electric continuity. The continuity must be provided through the use of a trademarked, well-established method acceptable to the Engineer.
2. Polyvinyl Chloride Pipe. (Not available in 3-inch diameter). Joints shall be push-on type employing rubber gaskets which conform with ASTM F477 and joints which conform with ASTM D3139.
3. High Density Polyethylene (HDPE). Joints shall be butt fusion meeting the requirements of ASTM D3261. Electrofusion meeting the requirements of ASTM F1055 shall be used where necessary for pipe coupling or where approved by the engineer.

B. All joints for water services requiring joint restraint shall meet the following minimum requirements:

1. Mechanical Joints. Mechanical joints shall be installed with wedge action restraining glands, Mega-Lug by EBAA Iron Sales, Inc. or equal.
2. Push-on Joints. Restrained push-on joints for straight pipe shall be as shown on the plans or as recommended by Pipe Manufacturer. Restrained joint retainer rings shall be manufactured of ductile iron compatible with pipe. All nuts, bolts, and tie rods shall be stainless steel or with a corrosion-resistant coating. Restraints shall be Mega-Lug by EBAA Iron Sales, Inc. or equal.
3. All restrained joints shall have a pressure rating equal to that of the pipe.

2.6 WATER DISTRIBUTION SYSTEM PIPING

A. Underground pipes and fittings within the building can be as follows:

1. Ductile Iron conforming to AWWA C115 or C151 standards. The joints and connections method shall be per the manufacturers recommendations.

    a. Pipe joint bells shall be epoxy or primer coated ductile iron bell and serrated ring restraints or gripping wedge restraints and torque limiting twist-off nuts around the pipe circumference with low alloy steel tie bolts. Restraint to have minimum pressure rating and safety factor equal to or greater than pressure rating and safety factor of pipe and be designed specifically for the pipe material it’s applied on.
    b. Asphaltic or epoxy coated ductile iron follower gland mechanical joint restraint with gripping wedge restraints and torque limiting twist-off nuts around the pipe circumference, low alloy steel T-bolts and UL listing or Factory Mutual approval.

c. Wrapped in 8 mil tube or sheet polyethylene encasement of iron pipe and pipe fittings, AWWA C105.
d. Concrete thrust blocks and threaded rods as required.

2. Poly Vinyl Chloride (PVC) conforming to AWWA C900 standards for 4" and larger. The joints and connections method shall be per the manufacturers recommendations.

a. Pipe joint bells shall be epoxy or primer coated ductile iron bell and serrated ring restraints or gripping wedge restraints and torque limiting twist-off nuts around the pipe circumference with low alloy steel tie bolts. Restraint to have minimum pressure rating and safety factor equal to or greater than pressure rating and safety factor of pipe and be designed specifically for the pipe material it's applied on.
b. Concrete thrust blocks and threaded rods as required.

3. Polyethylene (PE) conforming to AWWA C906 or 901 standards for 4" and larger. The joints and connections method shall be per the manufacturers recommendations.

a. Pipe joint bells shall be epoxy or primer coated ductile iron bell and serrated ring restraints or gripping wedge restraints and torque limiting twist-off nuts around the pipe circumference with low alloy steel tie bolts. Restraint to have minimum pressure rating and safety factor equal to or greater than pressure rating and safety factor of pipe and be designed specifically for the pipe material it's applied on.
b. Concrete thrust blocks and threaded rods as required.

B. Above ground pipes and fittings within the building shall be as follows:

1. Type "L" hard copper. ASTM B42, ASTM B88 standards.
2. Stainless Steel. ASME B36.19M; ASTM A270; ASTM A450 Standards.

C. Reverse Osmosis; Deionized; Filter / Purified; Water System Piping shall be as follows:

1. Sch. 80 PVDF pipe and socket fusion fittings. ASTM D2657, ASTM D3222, ASTM D2447 Standards. System valves shall by PVDF. Orion system or equal.

2.7 JOINTS FOR WATER DISTRIBUTION SYSTEM PIPING

A. Sweat joints shall be as follows:

1. Wrought copper sweat fittings. Joints shall have 95-5 solder and made with lead free paste flux mechanically cleaned before soldering. ASTM B32 standards.

B. Mechanical formed joints shall be as follows:

1. Mechanical grooved fittings and piping 2" or larger may be used in lieu of soldered fittings.

a. Mechanical grooved pipe couplings and fittings, ASTM F1476, as manufactured by Victaulic, Gruvlok or Grinnell may be used with cut groove galvanized steel pipe, cut groove ductile iron pipe or roll groove copper pipe where noted. Mechanical grooved components and assemblies to be rated for minimum 250 psi working pressure.

b. All mechanical grooved pipe material including gaskets, couplings, fittings and flange adapters to be from the same manufacturer.
c. Couplings to be malleable iron, ASTM A47, or ductile iron ASTM A536 with painted finish. Reducing couplings are not acceptable.
d. Fittings used on galvanized steel pipe to be malleable iron, ASTM A47, or ductile iron A536, with galvanized finish, ASTM A153. Fittings used on ductile iron pipe to be cement mortar lined ductile iron with coal tar coating, ASTM A536; conforming to requirements of AWWA C110/c153 and AWWA C606. Fittings used on copper pipe to be copper.
e. Gaskets to be EPDM, ASTM D2000. Gaskets for hot water systems and dry pipe systems to be flush seal design. Heat treated carbon steel oval neck track bolts and nuts, ASTM A183, with zinc electroplated finish ASTM B633.
f. Flange adapters to be ductile iron, ASTM A536; except at lug type butterfly valves where standard threaded flanges shall be used.

2. Mechanical formed brazed tee connections on piping 2" and larger may be used in lieu of specified tee fittings for branch take-offs up to one-half the diameter of the main.
3. Mechanical pressed fittings shall be rated for system application and connecting pipe material. Fittings shall have an EPDM sealing element and a noticeable indicator of a secure press connection. The Contractor shall from manufacturer's specifications submittal for review by the Engineer.

2.8 VALVES

A. Potable water valves shall meet the Wisconsin Lead Free Act for 2014.

B. In general, all valves shall be of standard dimensions and suitable for a minimum 150 lbs. working pressure. Provide ball valves for piping 2" and smaller and gate or butterfly valves for piping 2 ½" and larger.

C. Ball valves shall be full port similar to Nibco S or T -FP-600A-LF. Ball valves shall have extended tee handle to prevent any interference with the pipe insulation and of the operators hand while operating the valve. Extended tee handle shall be similar to Nibco CS Extended Lever Handle.

D. Gate valves shall be similar to Nibco F-617-0.

E. Butterfly valves shall be similar to Nibco LD-2000.

F. Check valves shall be similar to Nibco S or T -480-Y-LF for piping 2" and smaller and Nibco #W-9l0 for piping larger than 2".

G. Balancing valves, calibrated type, circuit setters equal to Bell & Gossett CB Lead Free Circuit Setter Plus Calibrated Balance Valves. Provide a ball valve and check valve downstream of the balancing valve in the water flow direction.

H. Solenoid – ASCO 210 valves – Brass body. The solenoid valves shall be normally open. Normally open solenoid valves allow flow when de-energized, this way their fail-safe position is open.

I. Boiler drain valves shall be similar to Nibco #74-CL.

J. Manufacturers shall be as listed above, Apollo, Nibco, Hammond, Milwaukee, Watts or an acceptable approved equal approved by the engineer. No private label wholesale products will be accepted.

2.9 BACKFLOW PREVENTERS

A. Backflow Preventers includes all Reduce Pressure Zone Assembly and Vacuum Breakers.

B. Backflow Preventer shall conform to ASME, ASSE standards and approved by the State of Wisconsin per outlet application.

C. Backflow Preventers shall be installed per Wisconsin Uniform Plumbing Code.

D. All water supply piping to plumbing fixtures and equipment and any other equipment shall be so arranged as to prevent a cross connection between the water supply and the drainage system. Provide sight or hub drains for backflow preventers: reduce pressure zone assembly, vacuum breakers or any approved method to accomplish a safe, uncontaminated water supply system in compliance with the Wisconsin Uniform Plumbing Code.

E. Manufacturers shall be Apollo, Watts, Zurn or an acceptable approved equal approved by the engineer. No private label wholesale products will be accepted.

2.10 PRESSURE REDUCING VALVES

A. Pressure Reducing Valves shall conform to ASME, ASSE standards and approved by the State of Wisconsin per outlet application.

B. Pressure Reducing Valves shall be installed per Wisconsin Uniform Plumbing Code. Outlet pressure shall be set at 80psig.

C. Pressure Reducing Valves shall have isolating valves, pressure gauge with strainer.

D. Pressure Reducing Valves shall be installed upstream of water supply piping to plumbing fixtures and equipment and any other equipment shall be so arranged as to prevent a static and residual water pressure over the manufacturer’s recommendations.

E. Manufacturers shall be Apollo, Watts, Zurn or an acceptable approved equal approved by the engineer. No private label wholesale products will be accepted.

2.11 PRESSURE GAUGES

A. Pressure Gauges shall be similar to Trerice vapor actuated pressure gauge with cast aluminum 4 ½” dial with 0psig to 180psig range.

B. Manufacturers shall be, Trerice 600CB, Marsh or an acceptable approved equal approved by the engineer. No private label wholesale products will be accepted.

2.12 THERMOSTATIC MIXING VALVES

A. Thermostatic Mixing Valves shall conform to ASME, ASSE standards and approved by the State of Wisconsin per outlet application.

B. Thermostatic Mixing Valves shall be installed per Wisconsin Uniform Plumbing Code.

C. Thermostatic Mixing Valves shall be exposed or accessible by means of access panels.

D. Size thermostatic mixing valves per the flow rate of the outlet application per the manufacture recommendation.

E. Manufacturers shall be Apollo, Leonard, Symmons, Watts, Zurn or an acceptable approved equal approved by the engineer. No private label wholesale products will be accepted.

2.13 THERMOMETERS

A. Thermometers shall be similar to Trerice vapor actuated thermometers with cast aluminum 9” adjustable angle rectangle with 40ºF to 240ºF range.

B. Manufacturers shall be, Trerice BX9, Marsh or an acceptable approved equal approved by the engineer. No private label wholesale products will be accepted.

2.14 WATER HAMMER ARRESTORS

A. Water Hammer Arrestors shall conform to ASME, NSF/ANSI 61, ASSE 1010 standards and approved by the State of Wisconsin per outlet application.

B. Water Hammer Arrestors shall be installed at locations in the piping system as required to accomplish noiseless operation of the system under all operating conditions.

C. Water Hammer Arresters shall be exposed or accessible by means of access panels.

D. Size and locate water hammer arrestors outlet application per the manufacture recommendation.

E. Manufacturers shall be, Precision Plumbing Products, Sioux Chief, Watts, Zurn.or an acceptable approved equal approved by the engineer. No private label wholesale products will be accepted.

2.15 UNIONS AND FLANGES

A. Provide unions or flanges for all backflow preventers, check valves, water heater connections, or wherever is required for proper piping and equipment installation. Provide insulating dielectric type unions or flanges with isolation kits between pipe of dissimilar metals.

B. Manufacturers shall be as listed above, Apollo, Nibco, Hammond, Milwaukee, Watts, Zurn or an acceptable approved equal approved by the engineer. No private label wholesale products will be accepted.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Field verify that all equipment and fixtures are in compliance with approved submittal drawings.

3.2 FIELD MEASUREMENTS

A. Field verify all measurements. Do not base on contract drawings.

B. Identify conflicts with the work of other trades prior to installation of work.

C. Adjust system to satisfy field requirements.

3.3 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Maintain original quality and condition of equipment while it is in storage.

3.4 INSTALLATION

A. General

1. See specifications section 22 05 00 - Plumbing Requirements for more information.

B. Testing and Commissioning

1. All testing that is required for the installation of the system specified shall be done by this Division's contractor prior to painting, backfilling, installation of pipe covering, or concealment within the building construction.
2. All tests shall be conducted in the presence of and to the satisfaction of the inspector having jurisdiction.
3. Testing shall be conducted in accordance with the Wisconsin Uniform Plumbing Code or as hereinafter specified.
4. Repair any leaks that occur during testing, and retested until no leaks occur for the installation of the system specified shall be done by this Division's contractor.
5. The system specified shall be tested and proved watertight under a water pressure not less than 150 PSI for a period of two hours.
6. All thermometers and pressure gauges shall be located so they can be viewed from the floor and in the upright position.
7. Domestic hot water and hot water return system shall run us at a maximum velocity of 5 feet per second for heat maintenance. Provide balancing valve downstream of pump per design required flow per equipment schedule.
8. Provide additional balancing valves in the piping system as required to maintain the design required flow and maximum velocity. Where domestic hot water return branch piping connect to the main domestic hot water return loop, a balancing valve shall be installed on the branch pipe.

9. After the water heater(s) and circulating pump(s) are placed in operation, the Plumbing Contractor shall balance the domestic hot water distribution system. Balancing valves shall be balanced with approved tools, such as a manometer to calibrate proper flow. The final balancing of the domestic hot water distribution system shall provide hot water within 5 seconds at the most remote plumbing fixture when operated after 1 hour of non-operation.
10. Route hot water return piping within two feet of the plumbing fixtures used for hand washing in accordance with IECC C404.5.1.
11. All Flushing and disinfection of the potable water supply system shall be conducted in accordance with the Wisconsin Uniform Plumbing Code or as hereinafter specified.

3.5 OWNER TRAINING (NONE)

3.6 SPARE EQUIPMENT (NONE)

END OF SECTION 221100

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SECTION 221113 - FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. The requirements of the Contract Documents, including the General Conditions, the Supplementary Conditions, and Division I - General Requirements apply to this Section except as modified herein.

B. The work to be performed under this Section includes the furnishing of all materials, parts, labor, tools, equipment, and supervision necessary for the installation and testing of the water distribution system and appurtenances.

C. Construction, by other trades and other sections, will be occurring concurrent with work by this Section. Cooperation in the scheduling of work, delivery of materials and storage of same will be required.

1.2 RELATED SECTIONS

A. Section 312000 – Earth Moving

B. Section 311000 – Site Clearing

C. Section 312500 – Erosion and Sediment Control

1.3 RELATED DOCUMENTS

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

B. Geotechnical Engineering Services Report for the Public Safety Building, Prairie du Chien, Wisconsin prepared by Professional Services Industries, Inc., dated May 7, 2024.

C. All work performed and material supplied shall conform to the *Standard Specifications for Sewer and Water Construction in Wisconsin*, Sixth Edition, dated December 22, 2003, with latest addenda, and the Wisconsin State Administrative Code, unless otherwise called for on the plans and specifications.

D. American Society of Mechanical Engineers (ASME)

1. ASME B 16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

E. American Standards for Testing and Materials (ASTM)

1. ASTM B88 - Seamless Copper Water Tube

2. ASTM D1784 - Rigid Poly Vinyl Chloride (PVC) Compounds and Chlorinated Poly Vinyl Chloride (CPVC) Compounds

3. ASTM D2241 - Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR-Series)

4. ASTM D2564 - Poly Vinyl Chloride (PVC) Solvent Cement

5. ASTM D2672 - Poly Vinyl Chloride (PVC) Integrally Molded Bell Ends For Solvent - Cemented Pipe Joints.

6. ASTM D3139 - Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals

7. ASTM F477 - Elastomeric Gaskets And Lubricant

8. ASTM F656 - Poly Vinyl Chloride (PVC) Cement Primer

F. American Water Works (AWWA)

1. AWWA C104 – Cement-Mortar Lining For Ductile-Iron Pipe and Fittings For Water

2. AWWA C105 – Polyethylene Encasement for Ductile Iron Piping for Water and other Liquids

3. AWWA C116 – Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service

4. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids

5. AWWA C153 - Ductile-Iron Compact Fittings for Water Service

6. AWWA C500 - Gate Valves for Water and Sewage Systems

7. AWWA C550 - Protective Interior Coatings for Valves And Hydrants

8. AWWA C504 - Rubber-Seated Butterfly Valves

9. AWWA C600 - Installation of Ductile-Iron Water Mains and Appurtenances

10. AWWA C605 - Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings For Water

11. AWWA C651 - Disinfecting Water Mains

12. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inches Through 12 Inches, for Water Distribution

G. National Fire Protection Association (NFPA)

1. NFPA 24 - Installation of Private Fire Service Mains and Their Appurtenances

1.4 QUALITY ASSURANCE

A. Perform installation in accordance with Standard Specifications, utility company, and municipality requirements.

B. Mark manufacturer's name and pressure rating on the valve body.

C. Perform disinfection of potable lines in accordance with AWWA C651.

1.5 ACTION SUBMITTALS

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

B. Shop Drawings:
   a. Water Service Pipe: Include material type, specifications.

PART 2 - PRODUCTS

2.1 TRENCH SECTIONS

A. Trench section for water main shall be in accordance with Section 4.3.0 and File No. 36 of the Standard Specifications for Sewer and Water Construction in Wisconsin. Stone chip bedding conforming to 8.43.2(a) or sand bedding conforming to 8.43.2(c) is required, and shall extend 12 inches above the top of pipe.

B. Granular backfill meeting the requirements of Section 8.43.4 shall be used under pavement, extending five feet out from the edge of pavement. Spoil backfill may be used in trenches outside of pavement areas. Spoil backfill shall conform to "Excavated Material" meeting the requirements of Section 8.43.5 of the Standard Specifications for Sewer and Water Construction in Wisconsin unless otherwise noted on the plans.

2.2 PIPE MATERIALS

A. Water main pipe shall be polyvinyl chloride water pipe (PVC) conforming to the requirements of AWWA C900 (4-inch to 12-inch diameter) or AWWA C905 (14-inch through 36-inch), Pressure Class 235. Pipe diameters shall conform to the outside diameter of ductile iron pipe with a dimension ratio of 18, with integral bell and spigot joints with an elastomeric seal.

2.3 FITTINGS

A. All fittings shall be cement lined ductile iron, bituminous coated designed for a service pressure of 150 psi and provided with mechanical joints.

B. Mechanical joints shall be made with "Cor Ten" nuts and bolts, or approved corrosion-resistant equivalents which conform to AWWA C111.

C. Fittings and their installation shall conform to all appropriate requirements of Part IV of the Standard Specifications for Sewer and Water Construction in Wisconsin.

D. All metal pipe and fittings shall be wrapped with polyethylene wrap meeting the requirements of Chapter 8.21.0. Installation of the wrap shall conform to Section 4.4.4.

E. Solid plugs shall be furnished where so specified on the plans. Plugs shall be Clow F-1165, F-1155, F-1159 solid plug or equal.

2.4 TRACER WIRE

A. Tracer Wire

Tracer wire shall be installed on all non-metallic sanitary sewer, storm sewer and water main, including respective laterals, in accordance with sections 4.3.14, 8.23.4, and File No. 24A and 24B of the Standard Specifications for Sewer & Water Construction in Wisconsin. Tracer wire shall be at a minimum 12-gauge PVC coated.

2.5 VALVES

A. All valves shall be as noted on the plans: All valves shall have non-rising stems, mechanical joint ends, turning left to open, and have a 2 inch square operating nut.

B. Valves 16 inches or less shall be placed in valve boxes. All valve boxes shall be Size DD, three-piece assembly screw type box Clow F-2450 or equal. Covers shall be marked “WATER”.

C. Valve boxes shall be set truly vertical and so supported until sufficient backfill has been placed to ensure the vertical alignment of the box. All boxes shall be supported by footing blocks. All boxes shall be set to proposed grade. A butterfly valve box adaptor shall be used to prevent settling or shifting of the valve boxes.

2.6 WATER SERVICES

A. A minimum of 6 feet of cover shall be maintained on all water services.

B. The termination of all service trenches and all stubs for future extensions shall be marked with a 10 foot maple heart stake. Maintenance of these stakes is the responsibility of the Utility Contractor with the completion of his work. At that time, the presence of the stakes will be verified by the Owner’s representative, replacements made by the Contractor, and all stakes painted a bright color as directed by the Owner.

2.7 TAPPING SLEEVES

A. Rated at 200 psi working pressure up to 12” diameter and 150 psi working pressure above 12" diameter.

B. Outlet Joint: Mechanical joint allowing use of standard MJ x MJ valve.

C. Ductile Iron Pipe:

1. Sleeve and outlet flange: Ductile Iron.

2. Gasket: Full-length waffle style 360 degrees virgin rubber compound around the pipe.

3. Manufacturer: Waterous or Municipal Engineer approved equal.

D. Polyvinyl Chloride (PVC) Pipe:

1. Sleeve and outlet flange: 304 stainless steel.

2. Bolts, Nuts, and washers: 304 stainless steel.

3. Gasket: Full-length waffle style 360 degrees virgin rubber compound around the pipe.

4. Manufacturer: Romac Industries, Inc. or Municipal Engineer approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. It shall be the requirement, herein, that PRIOR to any water main construction, the Contractor shall carefully uncover the existing water mains at the points of connection. After satisfying himself that the alignment and elevation are satisfactory, construction may commence. If alterations are required, the Engineer shall be notified for authorization.

3.2 PREPARATION

A. The Contractor will be required to notify the Engineer of any unstable soils encountered during excavation.

B. Ream pipe and tube ends and remove burrs.

C. Remove scale and dirt on inside and outside before assembly.

D. Prepare pipe for connections to equipment with flanges or unions.

3.3 INSTALLATION

A. All trenches within paved areas, including lateral trenches, shall be backfilled with GRANULAR BACKFILL to the level of the surrounding ground surface at the time backfilling occurs.

B. The recommendation for Utility Installation found in the Geotechnical Engineering Services Report should be followed.

3.4 DISINFECTION

A. Pipe disinfecting shall meet AWWA C651 requirements. The mains shall be flushed and tested in the presence of the Utility Inspector.

B. Pressure testing and safe water sampling shall be the responsibility of the Contractor. Signed test reports on the water samples taken for an approved laboratory shall be provided to the Engineer prior to any connection to existing mains.

END OF SECTION 221113

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SECTION 221200 - SANITARY DRAIN, WASTE AND VENT SYSTEM

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work under this Section.

1.2 DESCRIPTION OF WORK

A. Furnish and install a complete and operable mechanical system as indicated on the drawings and as specified herein.

B. Materials:

1. Materials shall conform to the standard prescribed in the Wisconsin Uniform Plumbing Code and be approved for use by the Department of Safety and Professional Services, Division of Technical Services. When required, Plumbing Contractor shall obtain approval prior to installation.
2. All materials required for the work shall be new, of first-class quality and shall be furnished, delivered, erected, connected and finished in every detail and shall be so selected and arranged as to fit into the building spaces.

C. Materials Not Included:

1. N/A.

1.3 SHOP DRAWINGS

A. Submit electronic files with dimensions, capacities, and information as soon as available from manufacturers.

1.4 QUALITY ASSURANCE

A. All materials and parts shall be new and unused of current manufacture.

B. Provide all necessary accessories required for a complete and operable system.

1.5 WARRANTY

A. Materials and workmanship shall be warranted for a period of not less than (1) year from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

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.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials shall be new (less than 1 year old when turned over to the Owner).

2.2 MANUFACTURERS

A. Category types shall be of the same manufacturer.

B. No private label wholesale products will be accepted.

2.3 DRAIN, WASTE AND VENT SYSTEMS PIPING

A. Underground pipes and fittings within the building can be as follows:

1. Service weight cast iron conforming to ASTM A74 and ASTM A888 standards. All cast iron soil pipes and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International. Hub and spigot joints shall have neoprene gaskets or No-hub pipe and fittings clamps for underground and above ground installations. No-hub pipe and fittings clamps shall be heavy duty, stainless steel shielded couplings for non-pressure, gravity flow applications only.

    a. Manufactures shall be Clamp-all - Hi-torq 125, Mission – Heavy Weight or Husky - 4000 series or an equal approved by the engineer.

2. Schedule 40 solid wall Poly Vinyl Chloride (PVC) conforming to ASTM D2665 standards. The joints and connections method shall be per the manufacturers recommendations.

B. Above ground pipes and fittings within the building can be as follows:

1. No- hub cast iron conforming to ASTM A74 and ASTM A888 standards. All cast iron soil pipes and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International. The joints and connections method shall be per the manufacturers recommendations. No-hub pipe and fittings clamps for underground and above ground installations. No-hub pipe and fittings clamps shall be heavy duty, stainless steel shielded couplings for non-pressure, gravity flow applications only.

a. Manufactures shall be Clamp-all - Hi-torq 125, Mission – Heavy Weight or Husky - 4000 series or an equal approved by the engineer.

2. Schedule 40 solid wall Poly Vinyl Chloride (PVC) conforming to ASTM D2665 standards. The joints and connections method shall be per the manufacturers recommendations.

C. High temperature drain and waste exceeding 120 degree Fahrenheit pipes and fittings within the building can be as follows:

1. No- hub cast iron conforming to ASTM A74 and ASTM A888 standards. All cast iron soil pipes and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International. The joints and connections method shall be per the manufacturers recommendations. No-hub pipe and fittings clamps for underground and above ground installations. No-hub pipe and fittings clamps shall be heavy duty, stainless steel shielded couplings for non-pressure, gravity flow applications only.

a. Manufactures shall be Clamp-all - Hi-torq 125, Mission – Heavy Weight or Husky - 4000 series or an equal approved by the engineer.

2. Schedule 40 solid wall Chlorinated Poly Vinyl Chloride (CPVC) conforming to ASTM F 2618 standards. The joints and connections method shall be per the manufacturers recommendations.

D. Pipes and fittings in plenums ceiling can be as follows:

1. Listed and labeled having a flame spread index of not more than 25 and a smoke-developed index of not more than 50 when tested in accordance with ASTM E 84 or UL 723.
2. Wrapped with a fire barrier plenum wrap listed and labeled when tested in accordance with ASTM E 84, ASTM E 136 and UL 1887. The fire barrier plenum wrap shall be non-asbestos, made from inorganic fibers that are encased in a scrim-reinforced foil, and can withstand exposure to specific fire conditions for 1-2 hours.
3. Wrapped with a 1” thick rigid fiberglass pipe insulation when tested in accordance with ASTM E 84 or UL 723 for installation over Poly Vinyl Chloride (PVC) assemblies installed in plenums. Such testing shall meet the criteria found in 22 12 00-2, 2.3.C.1.

2.4 TRAPS

A. Provide deep seal “P” traps per the specified material type.

2.5 VENT FLASHINGS

A. See plumbing drawing’s Pipe Penetration Detail.

B. Provide an approved watertight vent flashing where the roof system is penetrated by a vent terminal.

C. Vent flashings shall be material approved by the State of Wisconsin Uniform Plumbing Code.

D. Vent flashing shall be compatible with the type of roof system used.

E. See details on drawings for more information for installation requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Field verify that all equipment and fixtures are in compliance with approved submittal drawings.

3.2 FIELD MEASUREMENTS

A. Field verify all measurements. Do not scale off of drawings.

B. Identify conflicts with the work of other trades prior to the start of any work.

C. Adjust system as required field requirements.

3.3 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Maintain original quality and condition of equipment while it is in storage.

3.4 INSTALLATION

A. General

1. See specifications section 22 05 00 - Plumbing Requirements for more information.

B. Testing

1. All testing that is required for the installation of the system specified shall be done by this Division's contractor prior to painting, backfilling, installation of pipe covering, or concealment within the building construction.
2. All tests shall be conducted in the presence of and to the satisfaction of the inspector having jurisdiction.
3. Testing shall be conducted in accordance with the Wisconsin Uniform Plumbing Code or as hereinafter specified.
4. Repair any leaks that occur during testing, and retested until no leaks occur for the installation of the system specified shall be done by this Division's contractor.
5. The system specified shall be tightly closed and filled with water to the highest opening. The water shall be kept in the system for at least 15 minutes before inspections start. An air test of 5 pounds per square inch for a period of 15 minutes is also acceptable. The smoke test does not take the place of the water or air test.
6. After the sanitary drain, waste and vent system has been completed, but before the finished ceiling grid is installed, the Plumbing Contractor shall have a smoke test done on the entire drain and vent system. The testing shall be done by a company regularly engaged in the smoke testing of sewer, drain, and vent piping, such as American Leak Detection of

Hartland, Wisconsin, phone 262-538-5000 or 866-570-5325. Smoke shall be introduced into the system with the main sanitary building sewer sealed. Each roof penetration shall be sealed as smoke appears to pressurize the system. The Plumbing Contractor shall inspect the entire drain and vent system for leaks and traps that are not sealed before the smoke test is removed. The smoke test shall be witnessed by the Owner's representative and a report that a successful test was conducted shall be included in the operation and maintenance manual.

3.5 OWNER TRAINING (NONE)

3.6 SPARE EQUIPMENT (NONE)

END OF SECTION 221200

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SECTION 221300 - STORM AND CLEAR WATER DRAIN, WASTE AND VENT SYSTEM

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work under this Section.

1.2 DESCRIPTION OF WORK

A. Furnish and install a complete and operable mechanical system as indicated on the drawings and as specified herein.

B. Materials:

1. Materials shall conform to the standard prescribed in the Wisconsin Uniform Plumbing Code and be approved for use by the Department of Safety and Professional Services, Division of Technical Services. When required, Plumbing Contractor shall obtain approval prior to installation.
2. All materials required for the work shall be new, of first-class quality and shall be furnished, delivered, erected, connected and finished in every detail and shall be so selected and arranged as to fit into the building spaces.

C. Materials Not Included:

1. N/A.

1.3 SHOP DRAWINGS

A. Submit electronic files with dimensions, capacities, and information as soon as available from manufacturers.

1.4 QUALITY ASSURANCE

A. All materials and parts shall be new and unused of current manufacture.

B. Provide all necessary accessories required for a complete and operable system.

1.5 WARRANTY

A. Materials and workmanship shall be warranted for a period of not less than (1) year from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

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.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials shall be new (less than 1 year old when turned over to the Owner).

2.2 MANUFACTURERS

A. Category types shall be of the same manufacturer.

B. No private label wholesale products will be accepted.

2.3 CONDUCTORS, DRAIN, WASTE AND VENT SYSTEMS PIPING

A. Underground pipes and fittings within the building can be as follows:

1. Service weight cast iron conforming to ASTM A74 and ASTM A888 standards. All cast iron soil pipes and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International. Hub and spigot joints shall have neoprene gaskets or No-hub pipe and fittings clamps for underground and above ground installations. No-hub pipe and fittings clamps shall be heavy duty, stainless steel shielded couplings for non-pressure, gravity flow applications only.

    a. Manufactures shall be Clamp-all - Hi-torq 125, Mission – Heavy Weight or Husky - 4000 series or an equal approved by the engineer.

2. Schedule 40 solid wall Poly Vinyl Chloride (PVC) conforming to ASTM D2665 standards for 8” and larger. The joints and connections method shall be per the manufacturer’s recommendations.
3. Schedule 40 solid wall Poly Vinyl Chloride (PVC) conforming to ASTM D2665 standards for 6” and smaller. The joints and connections method shall be per the manufacturer’s recommendations.

B. Above ground pipes and fittings within the building can be as follows:

1. No- hub cast iron conforming to ASTM A74 and ASTM A888 standards. All cast iron soil pipes and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International. The joints and connections method shall be per the manufacturer’s recommendations. No-hub pipe and fittings

clamps for underground and above ground installations. No-hub pipe and fittings clamps shall be heavy duty, stainless steel shielded couplings for non-pressure, gravity flow applications only.

a. Manufactures shall be Clamp-all - Hi-torq 125, Mission – Heavy Weight or Husky - 4000 series or an equal approved by the engineer.

2. Schedule 40 solid wall Poly Vinyl Chloride (PVC) conforming to ASTM D2665 standards for 8" and larger. The joints and connections method shall be per the manufacturer's recommendations.
3. Schedule 40 solid wall Poly Vinyl Chloride (PVC) conforming to ASTM D2665 standards for 6" and smaller. The joints and connections method shall be per the manufacturer's recommendations.

C. Pipes and fittings in plenums ceiling can be as follows:

1. Listed and labeled having a flame spread index of not more than 25 and a smoke-developed index of not more than 50 when tested in accordance with ASTM E 84 or UL 723.
2. Wrapped with a fire barrier plenum wrap listed and labeled when tested in accordance with ASTM E 84, ASTM E 136 and UL 1887. The fire barrier plenum wrap shall be non-asbestos, made from inorganic fibers that are encased in a scrim-reinforced foil, and can withstand exposure to specific fire conditions for 1-2 hours.
3. Wrapped with a 1" thick rigid fiberglass pipe insulation when tested in accordance with ASTM E 84 or UL 723 for installation over Poly Vinyl Chloride (PVC) assemblies installed in plenums. Such testing shall meet the criteria found in 22 12 00-2, 2.3.C.1.

2.4 TRAPS

A. Provide deep seal "P" traps per the specified material type.

2.5 VENT FLASHINGS

A. See plumbing drawing's Pipe Penetration Detail.

B. Provide an approved watertight vent flashing where the roof system is penetrated by a vent terminal.

C. Vent flashings shall be material approved by the State of Wisconsin Uniform Plumbing Code.

D. Vent flashing shall be compatible with the type of roof system used.

E. See details on drawings for more information for installation requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Field verify that all equipment and fixtures are in compliance with approved submittal drawings.

3.2 FIELD MEASUREMENTS

A. Field verify all measurements. Do not scale off of drawings.

B. Identify conflicts with the work of other trades prior to the start of any work.

C. Adjust system as required field requirements.

3.3 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Maintain original quality and condition of equipment while it is in storage.

3.4 INSTALLATION

A. General

1. See specifications section 22 05 00 - Plumbing Requirements for more information.

B. Testing

1. All testing that is required for the installation of the system specified shall be done by this Division's contractor prior to painting, backfilling, installation of pipe covering, or concealment within the building construction.
2. All tests shall be conducted in the presence of and to the satisfaction of the inspector having jurisdiction.
3. Testing shall be conducted in accordance with the Wisconsin Uniform Plumbing Code or as hereinafter specified.
4. Repair any leaks that occur during testing, and retested until no leaks occur for the installation of the system specified shall be done by this Division's contractor.
5. The system specified shall be tightly closed and filled with water to the highest opening. The water shall be kept in the system for at least 15 minutes before inspections start. An air test of 5 pounds per square inch for a period of 15 minutes is also acceptable. The smoke test does not take the place of the water or air test.

3.5 OWNER TRAINING (NONE)

3.6 SPARE EQUIPMENT (NONE)

END OF SECTION 221300

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SECTION 221313 - FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 SUMMARY

A. The requirements of the Contract Documents, including the General Conditions, the Supplementary Conditions, and Division I - General Requirements apply to this Section except as modified herein.

B. The work performed under this Section includes the furnishing of all materials, parts, labor, tools, equipment, and supervision necessary for the installation and testing of the sanitary sewage collection system and appurtenances.

C. Construction, by other trades and other sections, will be occurring concurrent with work by this Section. Cooperation in the scheduling of work, delivery of materials and storage of same will be required.

1.2 RELATED SECTIONS

A. Section 31 20 00 – Earth Moving

B. Section 32 13 00 – Rigid Paving

C. Section 32 12 16 – Asphalt Paving

1.3 RELATED DOCUMENTS

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

B. All work performed and material supplied shall conform to the *Standard Specifications for Sewer and Water Construction in Wisconsin*, latest edition, and the Wisconsin State Administrative Code, unless otherwise called for on the plans and specifications.

C. American Standards for Testing and Materials (ASTM)

1. ASTM A74 – Cast Iron Soil Pipe and Fittings
2. ASTM A746 – Ductile Iron Gravity Sewer Pipe
3. ASTM C478 – Precast Reinforced Concrete Manhole Sections
4. ASTM C564 – Rubber Gaskets for Cast Iron Soil Pipe and Fittings
5. ASTM D1869 – Rubber Rings for Asbestos-Cement Pipe
6. ASTM D2241 - Poly Vinyl Chloride (PVC) Pressure-rated Pipe (SDR Series)
7. ASTM D3034 – Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings
8. ASTM D3035 – Polyethylene (PE) Plastic Pipe Using Flexible Elastomeric Seals
9. ASTM D3139 Joints for Plastic Pressure Pipe Using Flexible Elastomeric Seals
10. ASTM D3261 – Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene Plastic Pipe and Tubing
11. ASTM F477 - Elastomeric Gaskets And Lubricant
12. ASTM F1417 – Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air

1.4 QUALITY ASSURANCE

A. Perform installation in accordance with Standard Specifications, utility company, and municipality requirements.

B. The quality of material, process of manufacture and finished pipe shall be subject to inspection and approval by the Engineer.

1.5 ACTION SUBMITTALS

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

B. Shop Drawings:
   a. Manholes: Include plans, elevations, sections, details, frames, and covers, if applicable.

PART 2 - PRODUCTS

2.1 TRENCH SECTIONS

A. Trench section for flexible sewer pipe shall be Standard Section (Class B) in accordance with Section 3.2.6 of the Standard Specifications. Maximum allowable trench width shall be the outside diameter of the pipe plus 24 inches. Cover material over PVC pipe shall be 12 inches.

B. Granular backfill meeting the requirements of Section 8.43.4 shall be used under pavement, extending 5 feet out from the edge of pavement. Spoil backfill may be used in trenches outside of pavement areas. Spoil backfill shall conform to "Excavated Material" meeting the requirements of Section 8.43.5 of the Standard Specifications unless otherwise noted on the plans.

2.2 PIPE MATERIALS

A. Sanitary sewer and building sewer pipe shall be PVC PSM SDR-35 conforming to the requirements of ASTM D-3034. Where PVC (AWWA C900) SDR-18 is called for, it shall meet the requirements of ASTM D1869.

B. Joints for PVC sanitary sewer pipe shall be elastomeric gasket joints in accordance with Sections ASTM Designation F-477, latest revision.

2.3 MANHOLES

A. Manholes for sanitary sewer shall be the diameter as noted on the plans, precast concrete with rubber joints and eccentric cone and shall conform to the requirements of ASTM C478 and Chapter 3.5.0 and File No. 12 of the Standard Specifications.

B. All manhole steps shall be of gray cast conforming to the requirements of Section 8.40.1(b) of the Standard Specifications.

C. All manhole frames and lids supplied by the Contractor shall be Neenah R-1661, locking, non-rocking with no vent holes and a solid gasket. Internal/external manhole seals shall be on every manhole.

2.4 TRACER WIRE

A. Tracer wire shall be installed on all non-metallic sanitary sewer, including respective laterals, in accordance with sections 4.3.14, 8.23.4, and File No. 24A and 24B of the Standard Specifications for Sewer & Water Construction in Wisconsin. Tracer wire shall be at a minimum green 12-gauge PVC coated installed along the entire length. Tracer wire shall be brought to the surface at the edge of the building and enclosed in a locator box with "sewer" on the cover.

2.5 PIPE INSULATION

A. Protection from frost: Insulation must be provided for pipe if sufficient cover is not provided. See Section SPS 382.30 (11) (c) of the Wisconsin Code for frost protection requirements.

2.6 PIPE CONNECTIONS

A. Laterals connected to new PVC main line sewers shall be by factory wye, factory tee, Insert-A-Tee or Kor-N-Tee connections. No saddle connections will be allowed.

B. Laterals connected to new reinforced concrete main line sewers shall utilize Kor-N-Seal connections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. It shall be the requirement, herein, that prior to any sanitary sewer construction, the Contractor shall carefully uncover the existing sewers at the points of connection. After satisfying himself that the alignment and elevation are satisfactory, construction may commence. If alterations are required, the Engineer shall be notified for authorization.

3.2 PREPARATION

A. The Contractor will be required to notify the Engineer of any unstable soils encountered during excavation.

3.3 INSTALLATION

A. All trenches within paved areas, including lateral trenches, shall be backfilled with granular backfill to the level of the surrounding ground surface at the time backfilling occurs.

B. All connections to existing manholes shall be cored. A temporary plug must be provided in new sewer construction.

C. All building sewer services shall be installed in accordance with the Department of Commerce Chapters 82 to 87 Plumbing and the local plumbing code and regulations.

END OF SECTION 221313

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SECTION 221400 - NATURAL FUEL GAS DISTRIBUTION SYSTEM

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work under this Section.

1.2 DESCRIPTION OF WORK

A. Furnish and install a complete and operable system as indicated on the drawings and as specified herein.

B. Materials:

1. Materials shall conform to the standard prescribed in the Wisconsin Uniform Plumbing Code and be approved for use by the Department of Safety and Professional Services, Division of Technical Services. When required, Plumbing Contractor shall obtain approval prior to installation.
2. All materials and equipment required for the work shall be new, of first-class quality and shall be furnished, delivered, erected, connected and finished in every detail and shall be so selected and arranged as to fit into the building spaces.

C. Materials Not Included:

1. Items furnished by other Sections.

1.3 SHOP DRAWINGS

A. Submit electronic files with dimensions, capacities, and information as soon as available from manufacturers.

1.4 QUALITY ASSURANCE

A. All materials, equipment, and parts shall be new and unused of current manufacture.

B. Provide all necessary accessories required for a complete and operable system.

1.5 WARRANTY

A. Materials and workmanship shall be warranted for a period of not less than (1) year from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

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.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials shall be new (less than 1 year old when turned over to the Owner).

2.2 MANUFACTURERS

A. Category types shall be of the same manufacturer.

B. No private label wholesale products will be accepted.

2.3 GAS DISTRIBUTION SYSTEM PIPING

A. Above ground piping shall be as follows:

1. Black steel pipe, schedule 40, Type E, Grade B, ASTM A53.

2.4 JOINTS FOR GAS DISTRIBUTION SYSTEM PIPING

A. Threaded joints shall be as follows:

1. Black malleable iron threaded fittings, Class 150, ASTM A197/ANSI B16.3; seamless carbon steel weld fittings, standard weight, ASTM A234 grade WPB/ANSI B16.9.
2. Piping 2” and smaller shall be made with “Metallic” joint compound.
3. Piping 2 ½” and larger shall be made with welded fittings.

2.5 VALVES

A. In general, all valves shall be of standard dimensions and suitable for a minimum 125 lbs. working pressure. Provide ball valves for piping 2 and smaller and gate or butterfly valves for piping 2 ½” and larger.

B. Ball valves shall be full port similar to Nibco T -FP-600A for pipe mains and pipe branches. Ball valves shall be full port similar to Nibco GB1A for pipe connections to equipment.

C. Solenoid – ASCO 8210 valves – normally closed. The solenoid valves shall be normally closed. Normally closed solenoid valves allow flow when energized, this way their fail-safe position is closed.

D. Manufacturers shall be as listed above, Apollo, Nibco, Hammond, Milwaukee, Watts, Zurn or an acceptable approved equal approved by the engineer. No private label wholesale products will be accepted.

2.6 PRESSURE REDUCING VALVES

A. Pressure Reducing Valves shall conform to ASME, ASSE standards and approved by the State of Wisconsin per outlet application.

B. Pressure Reducing Valves for 5 psi inlets shall be similar to Maxitrol No. 325-L with lever acting design with overpressure protection device with vent limiter.

C. Pressure Reducing Valves for 2 psi inlets shall be similar to Maxitrol No. 325-L with lever acting design regulator with vent limiter.

D. Pressure Reducing Valves for 7”-14” w.c. inlets shall be similar to Maxitrol No. 325-L with lever acting design regulator with vent limiter.

E. Manufacturers shall be as listed above, Maxitrol or an acceptable approved equal approved by the engineer. No private label wholesale products will be accepted.

2.7 PRESSURE GAUGES

A. Pressure gauges shall be similar to Trerice vapor actuated dial pressure gauge with 4 ½” dial and 0º to 180psig range.

B. Manufacturers shall be as listed above, Trerice, Marsh or an acceptable approved equal approved by the engineer. No private label wholesale products will be accepted.

2.8 EQUIPMENT CONNECTORS HOSES

A. Equipment Connector Hoses shall conform to NSF / ANSI 169 and ANSIZ21.69.

B. Equipment Connector Hoses shall have carbon steel rotational fittings ends, 304 stainless steel tube with multi-strand stainless wire braiding, coated with PVC jacket that can withstand 350ºF and with restraining device from wall to equipment.

C. Equipment Connector Hoses shall be similar to Dormant Blue Hose – 1675BP.

D. Manufacturers shall be as listed above, Dormant by Watts, Regency or an acceptable approved equal approved by the engineer. No private label wholesale products will be accepted.

2.9 UNIONS AND FLANGES

A. Provide unions or flanges for all equipment or wherever is required for proper piping and equipment installation.

B. Manufacturers shall be as listed above, Apollo, Nibco, Hammond, Milwaukee, Watts, Zurn or an acceptable approved equal approved by the engineer. No private label wholesale products will be accepted.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Field verify that all equipment and fixtures are in compliance with approved submittal drawings.

3.2 FIELD MEASUREMENTS

A. Field verify all measurements. Do not base on contract drawings.

B. Identify conflicts with the work of other trades prior to installation of work.

C. Adjust system to satisfy field requirements.

3.3 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Maintain original quality and condition of equipment while it is in storage.

3.4 INSTALLATION

A. General

1. See specifications section 22 05 00 - Plumbing Requirements for more information.

B. Testing

1. All testing that is required for the installation of the system specified shall be done by this Division’s contractor prior to painting, backfilling, installation of pipe covering, or concealment within the building construction.
2. All tests shall be conducted in the presence of and to the satisfaction of the inspector having jurisdiction.
3. Testing shall be conducted in accordance with the Wisconsin Uniform Plumbing Code or as hereinafter specified.
4. Repair any leaks that occur during testing, and retested until no leaks occur for the installation of the system specified shall be done by this Division’s contractor.

5. The system specified shall be tested and proved watertight under an air pressure not less than 80 PSI for a period of two hours.

3.5 OWNER TRAINING (NONE)

3.6 SPARE EQUIPMENT (NONE)

END OF SECTION 221400

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SECTION 221500 - COMPRESSED AIR DISTRIBUTION SYSTEMS

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work under this Section.

1.2 DESCRIPTION OF WORK

A. Furnish and install a complete and operable mechanical system as indicated on the drawings and as specified herein.

B. Materials:

1. All materials and equipment required for the work shall be new, of first-class quality and shall be furnished, delivered, erected, connected and finished in every detail and shall be so selected and arranged as to fit into the building spaces.

C. Materials Not Included:

1. Equipment that used this sections piping system.

1.3 SHOP DRAWINGS

A. Submit electronic files with dimensions, capacities, and information as soon as available from manufacturers.

1.4 QUALITY ASSURANCE

A. All materials, equipment, and parts shall be new and unused of current manufacture.

B. Provide all necessary accessories required for a complete and operable system.

1.5 WARRANTY

A. Materials and workmanship shall be warranted for a period of not less than (1) year from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

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.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials shall be new (less than 1 year old when turned over to the Owner).

2.2 MANUFACTURERS

A. Category types shall be of the same manufacturer.

B. No private label wholesale products will be accepted.

2.3 COMPRESSED AIR DISTRIBUTION SYSTEM PIPING

A. Underground piping can be as follows:

1. N/A.

B. Above ground piping can be as follows:

1. Type “L” hard copper. ASTM B42, ASTM B88 standards.
2. Black steel pipe, schedule 40, Type F, Grade A, ASTM A53.

2.4 JOINTS FOR COMPRESSED AIR DISTRIBUTION SYSTEM PIPING

A. Copper pipe joints shall be as follows:

1. Wrought copper sweat fittings. Joints shall have 95-5 solder and made with lead free paste flux mechanically cleaned before soldering. ASTM B32 standards.
2. Mechanical press fittings for gas distribution system shall not be included in the base bid. If the Contractor desires to use mechanical press fittings for distribution system, an informational bid shall be included.

B. Threaded joints shall be as follows:

1. Black malleable iron threaded fittings, Class 150, ASTM A197/ANSI B16.3; seamless carbon steel weld fittings, standard weight, ASTM A234 grade WPB/ANSI B16.9.
2. Piping 2” and smaller shall be made with “Metallic” joint compound.
3. Piping 2 ½” and larger shall be made with welded fittings.

2.5 VALVES

A. In general, all valves shall be of standard dimensions and suitable for a minimum 150 lbs. working pressure. Provide ball valves for piping 2 and smaller and gate or butterfly valves for piping 2 ½" and larger.

B. Ball valves shall be similar to Nibco #S-585-Y-LF for piping 1½" and smaller and Nibco #S-595-Y-LF for piping larger than 1½". Ball valves shall have extended tee handle to prevent any interference with the pipe insulation.

2.6 REGULATORS

A. See drawing's Compressed Air Termination Schedule for more information.

2.7 PRESSURE GAUGES

A. Pressure gauges shall be similar to Trerice vapor actuated dial pressure gauge with 4 ½" dial and 0º to 180psig range.

2.8 UNIONS AND FLANGES

A. Provide unions or flanges for all connections, or wherever is required for proper piping and equipment installation.

2.9 HANGERS, ANCHORS AND INSERTS

A. All piping in the plumbing system shall be supported with hangers in accordance with the provisions of the Wisconsin Uniform Plumbing / Mechanical Code.

B. The use of perforated strap hangers will not be acceptable.

C. Use approved malleable, wrought iron or steel pipe riser clamps for steel or cast iron lines and copper plated clamps for copper tubing.

D. Provide all necessary inserts for supporting piping and equipment.

E. Piping shall be supported with clevis or adjustable band loop hangers at intervals recommended by the manufacturer.

F. Manufacturers shall by B-Line, Anvil, Fee & Mason, Elcen or an equal approved by the engineer.

2.10 SUPPORTS

A. Provide all structural supports required for equipment included under this Division of the Work.

2.11 ESCUTCHEONS

A. Provide on all pipes passing through finished floors, walls and ceilings with outside diameter sufficient to cover sleeve opening and inside diameter to fit snugly around pipe.

B. Escutcheon plates shall be chrome plated brass.

2.12 IDENTIFICATION

A. All equipment, pipe and valves, etc., shall be identified as listed below.

B. All piping in this Division of the Work exposed, in access spaces or above ceilings shall be identified at minimum of 25' intervals and at least once in every room with, pipe marking labels, 2¼" color as required by A.N.S.I. standards.

C. Sprayed on pipe stencils letterings are not allowed.

D. Valve tags shall be 1 1/8" round brass tags with black numerals. Fasten tags to body of valves with copper or brass chain. Numerals on tags shall correspond to the record drawings.

E. Equipment and starters shall be identified with neat, clear, permanent labels.

F. Valve Charts:

1. Furnish three (3) charts listing all valves, giving their location in the building and describing the valve number, service, function, normal position, etc. One (1) chart encased in plastic to be mounted in the building maintenance office and the other two (2) charts delivered to the Architect for transmittal to the Owner.
2. Furnish one (1) overall floor plan showing the location of all valves and the corresponding number from the valve chart.

G. Manufacturers shall be W.H. Brady Co., Seton, or an acceptable approved equal approved by the engineer. No private label wholesale products will be accepted.

2.13 PIPE SLEEVES AND PENETRATIONS

A. See plumbing drawing's Pipe Penetration Detail.

B. Pipe sleeves and penetrations passing through fire walls, barriers, floors or ceilings shall be sealed with fire barrier caulking. 3-M Fire Barrier CP-25 caulk and 303 putty synthetic elastomers, U.L. rated.

C. Provide sleeves for pipes passing through masonry or concrete tunnels, basins equipment, walls and floors, seal all openings between pipe and sleeve with vinyl acrylic plastic.

D. Pipe sleeves passing through floors outside of chases shall be constructed of schedule 40 galvanized steel pipe ½" larger than pipe or pipe insulation and shall extend ½" above finished floors.

E. Pipe sleeves passing through walls, partitions, etc., for piping exposed to view shall be constructed of 20 gauge galvanized iron sleeves 1" larger than pipe or pipe insulation and shall extend ½" from the finished surfaces.

F. Pipe penetrations passing through masonry or concrete that are cored and below grade or subjected to water or ground water shall have its opening 1" larger than the outside diameter of the penetrating pipe and sealed with a mechanical link-seal. Locations shall include, but not limited to, tunnels, equipment basins, walls and floors.

G. Manufacturers for fire barriers shall be U.L. listed 3-M Fire Barrier CP-25 caulk, 303 putty synthetic elastomers or an acceptable approved equal approved by the engineer.

H. Manufacturers for mechanical link-seals shall be Garlock, Trumbul, or an acceptable approved equal approved by the engineer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify equipment is in compliance with approved submittal drawings.

3.2 FIELD MEASUREMENTS

A. Field verify all measurements. Do not base on contract drawings.

B. Identify conflicts with the work of other trades prior to installation of work.

C. Adjust system to satisfy field requirements.

3.3 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Maintain original quality and condition of equipment while it is in storage.

3.4 INSTALLATION - COMPRESSED AIR DISTRIBUTION SYSTEM PIPING

A. General

1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer's recommendations.
2. Install all materials, assemblies, fixtures and equipment in strict accordance with manufacturer's recommendations and instructions. Consult manufacturer for all diagrams, schematics, sizes, outlets, etc. before installing.

B. Installation of Piping

1. Install a 6” minimum depth dirt leg at the bottom of each vertical run and at each outlet connection.
2. Valves and regulators shall not be installed above any ceiling or in any ceiling plenums.
3. Piping shall not be installed in masonry on concrete partitions.
4. Pressure regulators shall be installed per manufacturer’s recommendations.

C. Electrical Coordination

1. See specifications section 22 05 00 - Plumbing Requirements for more information.
2. Electrical Contractor will furnish and install all power wiring to control panels, valves, equipment and other devices furnished by this Division’s contractor that is required for the operation of the plumbing system.
3. Provide manufacturer’s wiring diagrams to Electrical Contractor for all equipment and devices furnished by this Division’s contractor and as indicated to be wired by the Electrical Contractor.

D. Testing

1. All testing that is required for the installation of the system specified shall be done by this Division’s contractor prior to painting, backfilling, installation of pipe covering, or concealment within the building construction.
2. All tests shall be conducted in the presence of and to the satisfaction of the inspector having jurisdiction.
3. Testing shall be conducted in accordance with the Wisconsin Uniform Plumbing Code or as hereinafter specified.
4. Repair any leaks that occur during testing, and retested until no leaks occur for the installation of the system specified shall be done by this Division’s contractor.
5. The system specified shall be tested and proved air tight at 225 PSI for a period of two hours.

3.5 OWNER TRAINING

A. Provide minimum of one hour training on piping system and equipment operation.

3.6 SPARE EQUIPMENT (NONE)

END OF SECTION 221500

SECTION 223000 - PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work under this Section.

1.2 DESCRIPTION OF WORK

A. Furnish and install a complete and operable plumbing system as indicated on the drawings and as specified herein.

B. Provide and install plumbing equipment, water treating, water heater heating, waste intercepting, waste pumping, waste holding, etc. where shown on the drawings and as hereinafter specified.

C. All plumbing equipment installed for this project shall comply with the State of Wisconsin Uniform Plumbing Code.

D. All plumbing equipment furnished for this project shall comply with the State of Wisconsin Uniform Plumbing Code.

E. Plumbing equipment shall be constructed from a lead-free brass alloy where used in drinking water applications, shall be certified to be NSF61, Section 9 compliant.

1.3 SHOP DRAWINGS

A. Submit electronic files of drawings with dimensions, capacities, and information as soon as available from manufacturers.

1.4 QUALITY ASSURANCE

A. All materials, equipment, and parts shall be new and unused of current manufacturer.

B. Provide all necessary accessories required for a complete and operable system.

1.5 WARRANTY

A. Materials and workmanship shall be warranted for a period of not less than 1 year from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

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.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacturing of such items, and for which replacement parts are available. All materials and equipment shall be new (less than 1 year old when turned over to the Owner).

2.2 MANUFACTURERS

A. See plumbing drawings schedules sheet(s) for more information of specified manufacturer, model and acceptable alternates.

B. Category types shall be of the same manufacturer.

C. No private label wholesale products will be accepted.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify equipment is in compliance with approved submittal drawings.

3.2 FIELD MEASUREMENTS

A. Field verify all measurements. Do not base on contract drawings.

B. Identify conflicts with the work of other trades prior to installation of work.

C. Adjust system to satisfy field requirements.

3.3 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Maintain original quality and condition of equipment while it is in storage.

3.4 INSTALLATION

A. General

1. See details on drawings for more information for pipe routing and installation requirements.
2. All equipment shall be set in a true and level manner with connection to drain, waste, vent, and water supply pipes per manufacturer's specifications. Adjust all valves, water flow as required for proper operating per manufacturer's specifications, pack all stuffing boxes and leave work area in a finished, clean and satisfactory working condition.
3. Protect all equipment after they are set. This Division of the Work is responsible for them until the acceptance of the work, at which time all equipment shall be in satisfactory condition and in complete working order.
4. All bolting and fastening to walls, etc., must be with through type toggles and washer bolting. No screw and plug or expansion shield fastenings will be accepted. All equipment fastenings shall be made with steel bar supports and plates or other approved method.
5. Wall mounted equipment shall be rigidly supported by a hanger which is attached to structural members so that the load is not transmitted to the equipment connection or any other part of the plumbing system. Install bolts in hole provided in bottom rear of fixture to prevent lifting of front rim.
6. All equipment shall be accessible for removal and maintenance.
7. All equipment operate per the manufacturer's recommendations and start-up of shall be by a manufacturer's authorized technician.

B. Air Compressors

1. Provide connections to piping system with unions or flanges.
2. Extend condensate drain pipe full size to sanitary hub or site drain. Discharge via air-break.
3. Install inlet and outlet particulate filters per the manufacturer's installation requirement.
4. Set level on floor or stable surface.
5. Provide 4" concrete equipment pad.
6. Electrical Contractor shall bring and connect power to the air compressor(s).
7. Start-up shall be by a trained manufacturer approved technician.

C. Water Softeners

1. See detail for more information.
2. Provide all domestic water equipment's water connections with wye strainers with stainless screen, dielectric with dielectric unions or flanges.
3. Provide water isolation valves with bypass for each piece of equipment.
4. Water testing set shall be furnished for hardness test, complete with metal container for wall mounting.
5. Extend backwash / regeneration discharge pipe full size to sanitary hub or site drain discharge via air-break.
6. Provide salt for start-up and first regeneration.
7. Set level on floor or stable surface.
8. Provide 4" concrete equipment pad.
9. Electrical Contractor shall bring and connect power to the water softener(s).
10. Start-up shall be by a trained manufacturer approved technician.

D. Water Heaters – Natural Gas

1. See detail for more information.

2. Provide water connections with wye strainers with stainless screen, dielectric unions or flanges.
3. Provide water isolation valves on cold, hot and hot water return piping.
4. Provide thermometers on cold, hot and hot water return piping.
5. Provide gas isolation valve and gas pressure regulator on gas piping as required per water column of each piece of equipment.
6. Provide condensate drain waste piping with neutralizer kit prior to discharging to the sanitary drainage system as required per code and AHJ.
7. Extend relief valve discharge pipe full size to within 6" above floor.
8. Provide sealed exhaust and air intake piping for water heater(s) through the roof / exterior wall in per manufacturer's recommendations. Provide piping material per manufacturer's recommendations. Provide penetration flashings and seals as required. Coordinate all penetrations and pipe routing with other trades.
9. Set level on floor or stable surface.
10. Provide 4" concrete equipment pad.
11. Electrical Contractor shall bring and connect power to water heater(s).
12. Start-up shall be by a trained manufacturer approved technician.

E. Circulating Pumps

1. See detail for more information.
2. Provide all domestic water equipment's water connections with dielectric unions or flanges.
3. Provide inline aquastat to shut off pump at a delta T temperature drop of supply outlet temperature per equipment schedule.
4. Provide balancing valve downstream of pump to control pump flow.
5. Plumbing Contractor shall provide conduit and wires to connect circulating pump(s) to aquastat and flow switches.
6. Electrical Contractor shall bring and connect power to the circulating pump(s).
7. Start-up shall be by a trained manufacturer approved technician.

F. Expansions Tanks

1. See detail for more information.
2. Provide all domestic water equipment's water connections with dielectric unions or flanges. This includes water softeners, water heaters, storage tanks, expansion tanks, circulation pumps and thermostatic mixing valves.
3. Set tank pressure to static pressure at street or in system if higher. See water calculation for more information.

G. Thermostatic Mixing Valve

1. See detail for more information.
2. Provide all domestic water equipment's water connections with dielectric unions or flanges. This includes water softeners, water heaters, storage tanks, expansion tanks, circulation pumps and thermostatic mixing valves.
3. Provide isolation valves on cold, hot and hot water return piping.
4. Provide thermometers on cold, hot and hot water return piping.
5. Provide heat trap per the manufacturer's installation requirements.
6. Plumbing Contractor shall provide conduit and wires to connect plumbing system temperature sensor.

7. Electrical Contractor shall bring and connect power to the circulating pump(s).
8. Set outlet temperature per design required flow per equipment schedule.

H. Pressure Reducing Valve

1. Provide isolation valves.
2. Provide pressure gauges on inlet and outlet piping if not included in the schedule.
3. Set outlet pressure per design required flow per equipment schedule.

I. Grease Waste Interceptors - Interior

1. Provide a minimum of 18” clearance above interceptor for proper removal internal part.

J. Catch Basins

1. See detail for more information.
2. Provide heavy duty cast iron frames and covers frame and covers rated for vehicle traffic.
3. Provide concrete rings to bring frame and cover to grade / finish floor as required.
4. Provide precast concrete conforming to ASTM #C-478 standards.
5. Provide cast-in-place concrete base.
6. Provided watertight connections, pipe gaskets and concrete joints. Seal exterior joints and riser ring with bitumastic coal tar epoxy coating and seal the pickholes on the cover with a self-sealing application of bitumastic epoxy coating.
7. Excavation and backfill shall be done as described in Section of the piping system that it connects to.
8. Rim elevations must match the surrounding grade or pavement along with the required slope.

3.5 ELECTRICAL COORDINATION

A. Electrical Contractor will furnished and install all power wiring to control panels, valves, aquastats, low voltage transformer box, equipment and other devices furnished by this Division’s contractor that is required for the operation of the plumbing system.

B. Provide manufacturer’s wiring diagrams to Electrical Contractor for all equipment and devices furnished by this Division’s contractor and as indicated to be wired by the Electrical Contractor.

3.6 TESTING

A. All testing that is required for the installation of the equipment specified shall be done by this Division’s contractor prior to final inspection by the architect / engineer.

B. All tests shall be conducted in the presence of and to the satisfaction of the inspector having jurisdiction.

C. Testing shall be conducted in accordance with the Wisconsin Uniform Plumbing Code or as hereinafter specified.

D. Repair any leaks that occur during testing, and retested until no leaks occur for the installation of the system specified shall be done by this Division’s contractor.

E. The equipment specified shall be tested and proved watertight for normal operations per manufacturer's requirements.

3.7 OWNER TRAINING

A. Provide minimum of one hour training on each type of equipment and its operation and repair.

3.8 SPARE EQUIPMENT (NONE)

END OF SECTION 223000

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work under this Section.

1.2 DESCRIPTION OF WORK

A. Furnish and install a complete and operable plumbing system as indicated on the drawings and as specified herein.

B. Provide and install plumbing fixtures where shown on the drawings, scheduled and as hereinafter specified.

C. All plumbing fixtures installed for this project shall comply with the State of Wisconsin Uniform Plumbing Code chapter SPS384.

D. All faucets shall be constructed from a lead-free brass alloy, and where used in drinking water applications, shall be certified to be NSF61, Section 9 compliant.

1.3 SHOP DRAWINGS

A. Submit electronic files of drawings with dimensions, capacities, and information as soon as available from manufacturers.

1.4 QUALITY ASSURANCE

A. All materials, equipment, and parts shall be new and unused of current manufacturer.

B. Provide all necessary accessories required for a complete and operable system.

1.5 WARRANTY

A. Materials and workmanship shall be warranted for a period of not less than 1 year from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

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.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacturing of such items, and for which replacement parts are available. All materials shall be new (less than 1 year old when turned over to the Owner).

2.2 MANUFACTURERS

A. See plumbing drawings schedules sheet(s) for more information of specified manufacturer, model and acceptable alternates.

B. Category types shall be of the same manufacturer.

C. See plumbing drawings schedules sheet(s) for more information of specified fixtures, colors and finishes.

D. No private label wholesale products will be accepted.

2.3 PLUMBING FIXTURE LIST

A. See plumbing drawings schedules sheet(s) for more information of specified fixtures, colors and finishes.

B. Dishwasher: Dishwasher shall be furnished by the Owner. Plumbing Contractor shall install and make final waste and water connections. Discharge waste to sanitary system via air gap fitting as required per manufacturer’s requirements. Provide water hammer arrestor on water supply with shutoff valve as required per manufacturer’s requirements. Set dishwasher level and secure in accordance with manufacturer’s installation guidelines.

C. Kitchen Equipment: Kitchen equipment shall be furnished by Owner. Plumbing Contractor shall furnish and install all necessary traps, tail pieces, continuous waste fittings, supplies and stops, gas connections, indirect waste piping, etc., and make final connections to the kitchen equipment. Discharge waste to sanitary system via air gap fitting as required per manufacturer’s requirements. Provide backflow protection, water hammer arrestor on water supply with shutoff valve as required per manufacturer’s requirements.

D. Reverse Osmosis (RO) system shall be furnished by the Owner. Plumbing Contractor shall install and make final waste and water connections. Discharge waste to sanitary system via air gap fitting as required per manufacturer’s requirements. Provide backflow protection, water hammer arrestor on water supply with shutoff valve as required per manufacturer’s requirements. RO shall be level. Provide and install all low pressure (80 psi or less) piping as required for a complete and operational system.

PART 3 - EXECUTION

3.1 EXAMINATION

A. See contract drawings for more information.

3.2 FIELD MEASUREMENTS

A. Field verify all measurements. Do not base on contract drawings.

B. Identify conflicts with the work of other trades prior to installation of work.

C. Adjust system to satisfy field requirements.

3.3 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Maintain original quality and condition of equipment while it is in storage.

3.4 INSTALLATION

A. General

1. Install the fixtures shown on the plumbing drawings per this Division specifications.
2. Install all products per manufacturer's specifications, requirements and recommendations.
3. See drawings for more information.
4. All fixtures shall be set in a firm and level manner with connection to drain, waste, vent, and water supply pipes per manufacturer's specifications. Adjust all valves, water flow as required for proper operating per manufacturer's specifications, pack all stuffing boxes and leave work area in a finished, clean and satisfactory working condition.
5. Protect all fixtures after they are installed. This Division of the Work is responsible for them until the acceptance of the work, at which time all fixtures shall be in satisfactory condition and in complete working order. Strictly advise all other Divisions with signs, protective plastic wrapping or coverings to prevent in under authorized usage.
6. All bolting and fastening to walls, etc., must be with through type toggles and washer bolting. No screw and plug or expansion shield fastenings will be accepted. All fixture fastenings shall be made with steel bar supports and plates or other approved method.
7. Wall mounted fixtures shall be rigidly supported by a concealed carrier which is firmly attached to structurally sound floor. Occupant loads from the fixture's use shall not be transmitted to the fixture connections or any other part of the plumbing system. Install bolts in hole provided in bottom rear of fixture to prevent lifting and sliding movements of the fixture.
8. Floor mounted fixtures shall be firmly set to structurally sound finish floor. Occupant loads from the fixture's use shall not be transmitted to the fixture connections or any other part of the plumbing system. Install bolts in hole provided in fixture to prevent lifting and sliding movements of the fixture.

9. Top mounted drop-in fixtures shall be firmly set in place with 100% clear mildew-resistant silicone caulk.
10. Under mounted suspended fixtures shall be firmly set in place with 100% clear mildew-resistant silicone caulk.
11. Seal all openings between the fixture and floors / walls with a 100% mildew-resistant silicone caulk. Provide white caulk for white fixtures with surfaces adjacent to walls. Provide clear caulk for white fixtures with surfaces adjacent to floors. Provide clear caulk for colored fixtures with surfaces adjacent to floors / walls.
12. All fixtures shall be accessible for removal and maintenance.
13. All fixtures shall operate per the manufacturer's recommendations.

B. Floor, Wall and Pipe Cleanouts

1. Cleanouts shall be accessible for normal operation.
2. Floor cleanouts shall be set level and be flush with the adjacent finished floor.
3. Wall cleanouts inside cover plate shall be flush with the adjacent finished wall.
4. Wall cleanouts shall be located below ADA grab bars.
5. Pipe cleanouts shall match the piping system material.
6. See plumbing fixture schedule for more information.

C. Floor Mounted Drains and Receptors

1. Drains shall have "P" trap same size as drain outlet.
2. Drain shall be set level and at height to allow proper pitch of floors toward drain as required.
3. See plumbing fixture schedule for rim height elevations.
4. Rim elevations must match the surrounding floor along with the required slope.
5. Provide safing material and installation shall conform to SPS384(4)9.

D. Roof Drains

1. Roof drain sump flashing shall be 4 lb. sheet lead extending from clamping ring to 18" beyond outside rim of drain. Flashing shall be set on soft roofing cement before Roofing Contractor applied roof coatings (Applies to built-up roofs). For membrane roofs, Plumbing Contractor shall clamp flashing ring to roofing as coordinated with Roofing Contractor.

E. Water Closets

1. Water closets shall be set level and rigidly supported. Carriers shall be used for all wall mount and wall outlet type fixtures.
2. Waste pipe wall stub out rough-in shall be made with the appropriate dimension for ADA or Non-ADA fixtures.
3. Waste pipe connection shall be made with a wall or floor flange be means of a neoprene gasket or wax ring.
4. Waste connection shall have a gas and water tight seal.
5. Water pipe wall stub out rough-in shall be made with the appropriate dimension for ADA or Non-ADA fixtures. ADA fixtures shall have its flush valve control handle on the open side of the fixture stall.
6. Water pipe wall stub out that is exposed to occupant use shall be rigid chrome plate brass.
7. Water connections shall have a water tight seal.

8. Flush valves shall operate per the gallons per flush per the fixture schedule.

F. Urinals:

1. Urinals shall be set level and rigidly supported. Carriers shall be used for all wall mount and wall outlet type fixtures.
2. Waste pipe wall stub out rough-in shall be made with the appropriate dimension for ADA or Non-ADA fixtures.
3. Waste connection shall have a gas and water tight seal.
4. Water pipe wall stub out rough-in shall be made with the appropriate dimension for ADA or Non-ADA fixtures. ADA fixtures shall have its flush valve control handle on the open side of the fixture stall.
5. Water pipe wall stub out that is exposed to occupant use shall be rigid chrome plate brass.
6. Water connections shall have a water tight seal.
7. Flush valves shall operate per the gallons per flush per the fixture schedule.

G. Lavatories

1. Lavatories shall be set level and rigidly supported. Carriers shall be used for all wall mount and wall outlet type fixtures.
2. Waste pipe wall stub out rough-in for ADA applications shall be made with the appropriate dimension which will allow the p-trap to set parallel with wall allowing space for the offset tail piece to be perpendicular with wall without any offsets.
3. Waste pipe wall stub out rough-in for Non-ADA applications shall be made so that the p-trap is perpendicular with wall without any offsets.
4. Waste pipe wall stub out shall have escutcheons that is tightly fitted over pipe serving the fixture.
5. Waste pipe wall stub out that is exposed to occupant use shall be rigid chrome plate brass.
6. Waste pipe wall stub out inside of case work shall be rigid chrome plate brass.
7. Waste p-traps shall be rigid chrome plate minimum 17 gauge brass having slip joint connection nuts with bottom dip cleanouts.
8. Waste tail piece shall be rigid chrome plate minimum 17 gauge brass having slip joint connection nuts.
9. Waste connection, p-trap and tail piece shall have a gas and water tight seal.
10. Water pipe wall stub out rough-in shall be made with the appropriate dimension which will allow the supply tube riser to be installed straight and a minimum of two 45 degree vertical offsets made with bending tool.
11. Water pipe wall stub out that is exposed to occupant use shall be rigid chrome plate brass.
12. Water pipe wall stub out inside of case work shall be rigid chrome plate brass.
13. Waste supply shut-off valve be rigid chrome plate brass with quarter turn stem, no plastic, with brass feral and compression connection nut.
14. Water supply tube riser shall be rigid chrome plate brass with compression connection nut. Stainless steel flexible braided supply tubes are not acceptable.
15. Water connections, supply shut-off valve and supply tube riser shall have a water tight seal.
16. Faucets shall operate per the gallons per minute per the fixture schedule.

H. Sinks

1. Sinks shall be set level and rigidly supported.

2. Waste pipe wall stub out rough-in for ADA applications shall be made with the appropriate dimension which will allow the p-trap to set parallel with wall allowing space for the offset tail piece to be perpendicular with wall without any offsets.
3. Waste pipe wall stub out rough-in for Non-ADA applications shall be made so that the p-trap is perpendicular with wall without any offsets.
4. Waste pipe wall stub out shall have escutcheons that is tightly fitted over pipe serving the fixture.
5. Waste pipe wall stub out that is exposed to occupant use shall be rigid chrome plate brass.
6. Waste pipe wall stub out inside of case work shall be rigid chrome plate brass.
7. Waste p-traps shall be rigid chrome plate minimum 17 gauge brass having slip joint connection nuts with bottom dip cleanouts.
8. Waste tail piece shall be rigid chrome plate minimum 17 gauge brass having slip joint connection nuts.
9. Waste connection, p-trap and tail piece shall have a gas and water tight seal.
10. Water pipe wall stub out rough-in shall be made with the appropriate dimension which will allow the supply tube riser to be installed straight and a minimum of two 45 degree vertical offsets made with bending tool.
11. Water pipe wall stub out that is exposed to occupant use shall be rigid chrome plate brass.
12. Water pipe wall stub out inside of case work shall be rigid chrome plate brass.
13. Waste supply shut-off valve be rigid chrome plate brass with quarter turn stem, no plastic, with brass feral and compression connection nut.
14. Water supply tube riser shall be rigid chrome plate brass with compression connection nut. Stainless steel flexible braided supply tubes are not acceptable.
15. Water connections, supply shut-off valve and supply tube riser shall have a water tight seal.
16. Faucets shall operate per the gallons per minute in the fixture schedule.

I. Electric Water Coolers

1. Electric Water Coolers shall be set level and rigidly supported. Carriers shall be used for all wall mount and wall outlet type fixtures.
2. Water connections, supply shut-off valve and supply tube riser shall have a water tight seal.
3. The fixture shall operate per the gallons per minute in the fixture schedule.
4. Electrical Connection.

    a. Plumbing Contractor shall connect to electrical outlet provide by the Electrical Contractor. Coordinate electrical outlet final location with the Electrical Contractor.

J. Shower

1. Shower valve, head and hand held slide bars/ rails shall be set level and rigidly supported.
2. Shower drain shall be set level and at height to allow proper pitch of floors toward drain as required.
3. Provide safing material and installation shall conform to SPS384(4)9.
4. Valves shall operate per the gallons per minute in the fixture schedule.

K. Service / Mop Sinks

1. Service / mop basin sink shall be set level and rigidly supported with a mixture of sand and cement.
2. Waste connection, neoprene gasket shall have a gas and water tight seal.
3. Water pipe wall stub out that is exposed to occupant use shall be rigid chrome plate brass.
4. Water connections shall have a water tight seal.
5. Faucets shall operate per the gallons per minute in the fixture schedule.

L. Barrier Free Requirements

1. All barrier free requirements shall comply with ADA Standards for accessible Design per USDOJ, ICC/ANSI A117.1 requirements and Wisconsin Building Code requirements.
2. All barrier free requirements shall comply with Architectural drawings heights for children.

M. Electrical Coordination

1. See specifications section 22 05 00 - Plumbing Requirements for more information.

N. Testing

1. All testing that is required for the installation of the fixtures specified shall be done by this Division's contractor prior to final inspection by the architect / engineer.
2. All tests shall be conducted in the presence of and to the satisfaction of the inspector having jurisdiction.
3. Testing shall be conducted in accordance with the Wisconsin Uniform Plumbing Code or as hereinafter specified.
4. Repair any leaks that occur during testing, and retested until no leaks occur for the installation of the system specified shall be done by this Division's contractor.
5. The fixtures specified shall be tested and proved watertight for normal operations per manufacturer's requirements.

3.5 OWNER TRAINING

A. Provide minimum of one hour(s) training on each type of fixtures and its operation and repair.

3.6 SPARE EQUIPMENT (NONE)

END OF SECTION 224000

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SECTION 23 05 00 - BASIC HVAC REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the contract, including General and Supplementary Conditions and Division 01 specification sections apply to work of this Section.

1.2 GENERAL

A. Hereinafter, the term “Mechanical Contractor” shall be intended and interpreted as defining the term “Heating, Ventilating and/or Air Conditioning Contractor”.

B. Hereinafter, the terms “Mechanical System” and “Mechanical Equipment” shall be intended and interpreted as defining the terms “Heating, Ventilating and/or Air Conditioning System or Equipment”.

C. If the bidding documents contain conflicting information or discrepancies between the plan sheets and details, plan sheets with other plan sheets, or the plan sheets and specifications, the bidder shall contact the Engineer in writing during the bidding process for verification of the correct information. Failure to verify the correct information with the Engineer during bidding will result in the Mechanical Contractor being responsible for any re-work deemed necessary by the Engineer at no additional cost to the Owner.

D. The drawings are schematic in nature. All required ductwork and piping offsets, transitions, fittings, supports, and specific manufacturer-required items/specialties shall be included in the base bid to accommodate actual field conditions. Final locations of all work shall be coordinated in the field and installed where directed by the Owner's Representative.

E. The Mechanical Contractor shall be responsible for coordinating construction phasing with the General Contractor. Furnish and install all temporary piping, ductwork, and control connections as required to facilitate the construction phasing.

1.3 REFERENCE STANDARDS

A. Abbreviations of standards organizations referenced in other sections are as follows:

1. AABC - Associated Air Balance Council
2. ABMA - American Boiler Manufacturers Assoc.
3. ADC - Air Diffusion Council
4. AGA - American Gas Assoc.
5. AMCA - Air Movement & Control Assoc.
6. ANSI - American National Standards Institute

7. ARI - Air Conditioning & Refrigeration Institute
8. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers
9. ASME - American Society of Mechanical Engineers
10. ASTM - American Society of Testing and Materials
11. AWWA - American Water Works Assoc.
12. AWS - American Welding Society
13. CGA - Compressed Gas Assoc.
14. CTI - Cooling Tower Institute
15. EPA - Environmental Protection Agency
16. GAMA - Gas Appliance Manufacturers Assoc.
17. IECC – International Energy Conservation Code
18. IEEE - Institute of Electrical & Electronics Engineers
19. IMC – International Mechanical Code
20. ISA - Instrument Society of America
21. MCA - Mechanical Contractors Assoc.
22. MICA - Midwest Insulation Contractors Assoc.
23. MSS - Manufacturer's Standardization Society of the Valve & Fitting Industry, Inc.
24. NBS - National Bureau of Standards
25. NEBB - National Environmental Balancing Bureau
26. NEC - National Electric Code
27. NEMA - National Electrical Manufacturers Assoc.
28. NFPA - National Fire Protection Assoc.
29. SMACNA - Sheet Metal & Air Conditioning Contractors National Association, Inc.
30. UL - Underwriters Laboratories, Inc.

1.4 QUALITY ASSURANCE

A. Substitution of Materials: Refer to Section GC - General Conditions of the Contract.

B. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, electrical characteristics/capacities, or engineering parameters from those indicated on the contract documents, the contractor is responsible for all costs involved in integrating the equipment or accessories into the system and for obtaining the performance from the system into which these items are placed. This may include changes found necessary during the testing, adjusting, and balancing phase of the project.

C. All equipment installed as part of this project shall be installed in accordance with the manufacturer's requirements.

1.5 PROTECTION OF FINISHED SURFACES

A. Refer also to Section GR - General Requirements

B. Furnish one can of touch-up paint for each different color factory finish which is to be the final finished surface of the product. Deliver touch-up paint with other "loose and detachable parts" as covered in the General Requirements.

1.6 CODES, PERMITS, TAXES AND CERTIFICATES OF INSPECTION AND APPROVAL

A. This system shall be installed in accordance with all national, state and local codes and regulations.

B. Mechanical equipment shall comply with the requirements of ASHRAE 90-1.

C. The Mechanical Contractor shall secure and pay for all permits, licenses and certificates of inspection applicable to this work.

D. The Mechanical Contractor shall pay for all taxes applicable to this work.

E. Copies of the certificates shall be included in the Operating and Maintenance Instructions.

1.7 AIR PLENUMS

A. Portions of the project include return air plenums. All materials located within air plenums shall be suitable for such use and shall meet all applicable flame and smoke development requirements.

1.8 GLYCOL SYSTEMS

A. The hot water system has been designed based on a glycol/water solution of 35% propylene glycol by volume. All coil performance data and pump selections have been based on this glycol solution percentage.

1.9 IDENTIFICATION

A. Equipment Labels

1. Furnish three-layer plastic laminate equipment labels with engraved letters, 1/16 inch thickness, beveled edges and self-bonding adhesive backing.

    a. Letter Color: Black.

    b. Letter Height: 1/2 inch.

    c. Background Color: White.

2. Label all major mechanical equipment including:

    a. Boilers.

    b. Variable Frequency Drives.

    c. Starters.

    d. Pumps.

    e. Air Cooled Compressor Condensing Units.

    f. Air Handling Units.

    g. Room Air Conditioning Units

    h. Energy Recovery Units.

    i. Fans.

B. Equipment Markers

1. Furnish clear adhesive label with black text at each VAV box, terminal heat pump, or other terminal unit located above the ceiling indicating unit tag number. Install on underside of nearest ceiling tee.

C. Piping and Ductwork Labeling

1. Manufacturers: W.H. Brady Co., Marking Services Inc. or Perma-Code B-350.

2. Furnish self-bonding pipe and duct markers of colors in accordance with ASME Standard A-13 with flow arrow tape indicating direction of flow for each system type.

3. Furnish marking as follows:

    a. Hot water supply.

    b. Hot water return.

    c. Refrigerant liquid.

    d. Refrigerant suction.

e. Refrigerant hot gas.

f. Gas piping.

g. Drain piping.

h. Supply air ductwork.

i. Return air ductwork.

j. Exhaust air ductwork.

k. Mixed air ductwork.

l. Outside air ductwork.

D. Valve Identification

1. Tag all valves in entire installation with brass tags stamped for clear identification. Provide an electronic copy in PDF format of valve schedule and necessary charts. Schedule to show:

a. Valve number.

b. Size.

c. Manufacturer.

d. Type of valve.

e. Type of service.

f. Location.

1.10 SHOP DRAWINGS

A. The Mechanical Contractor will be held responsible for correction of work deemed necessary by the Engineer due to proceeding with the work without certified drawings that have the Engineer's final review.

B. Submit to Engineer for review, an electronic copy of manufacturer's certified drawings in PDF format for all equipment. Drawings for the automatic controls shall include sequence description.

C. All major equipment shop drawings shall be of a single manufacturer. Submitting multiple manufacturers for a single product (i.e., VFDs, starters, AHUs, fan coil units, blower coil units, etc.) shall not be permitted. Only the BAS submittal may contain multiple manufacturers for the various products and components required for the complete system submittal.

D. Certified drawings shall include data on physical dimensions, gauges, materials of construction and capacities as follows:

1. All HVAC equipment.

2. Ductwork, flexible ductwork, and acoustical duct lining.

3. Piping systems. Submittal shall include a schedule listing each system type, pipe material, pipe size range, and connection type.

4. Piping and water or steam specialties as applicable.

5. HVAC insulation. Submittal shall include a schedule listing each system served, insulation material/type, and insulation thicknesses.

6. Photo documentation of rooftop unit roof curb installation as specified.

7. Refrigerant specialties.

8. Temperature control system.

9. Testing and balancing reports.

E. Incomplete certified drawings will be rejected.

F. Manufacturers shall check the plans and verify that their equipment can be installed in the space allotted and still have adequate room for servicing.

G. Review of certified drawings describing equipment that cannot fit in the space allotted does not relieve the Mechanical Contractor from furnishing and installing equipment that will meet the space requirements.

H. Review of certified drawings not fully describing or specifically stating all components of a major item or system shall not be construed to indicate that these items may be omitted or are not required. All components necessary to comply with the requirements of the system or the intent of the plans and specifications and all governing codes and regulations must be furnished and installed.

I. Review of certified drawings covering equipment that does not meet the requirements of the plans and/or specifications does not relieve the Mechanical Contractor from furnishing and installing the equipment required.

J. Review of certified drawings of a specified or substitute manufacturer other than the basis-of-design manufacturer does not relieve the Mechanical Contractor from furnishing and installing all required additional components to accommodate that manufacturer including additional support and/or structural steel due to differences in equipment dimensions and weights as well as differences in electrical loads and requirements.

1.11 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Refer also to Section GR - General Requirements.

B. Submit to Engineer for review, an electronic copy of the complete operating and maintenance manual in PDF format.

C. Assemble material in a single PDF file with a sidebar index with tabs for each type of equipment, certificates, warranties, as-builts, etc. In addition to the data indicated in the General Requirements, include the following information:

1. Copies of all approved shop drawings.

2. Manufacturer's wiring diagrams for electrically powered equipment.

3. Records of tests performed to certify compliance with system requirements.

4. Start-up reports for all major equipment.

5. Piping systems cleaning and flushing reports and verifications.

6. Certificates of inspection by regulatory agencies.

7. Temperature control record drawings and control sequences.

8. Parts lists for manufactured equipment with pricing.

9. Valve schedules.

10. Lubrication instructions, including list/frequency of lubrication done during construction.

11. Warranties.

12. As-built drawings.

D. Provide an electronic PDF file of the as-built drawings to the Engineer for record.

1.12 FILTERS

A. All equipment containing air filter media utilized for ventilation and/or heating purposes during construction shall have all filter media replaced regularly during construction with minimum MERV 8 filters to protect the internal components of the equipment. At the end of construction, all air filtered equipment shall be provided with new filter media with MERV ratings as scheduled, and all permanent filter media thoroughly cleaned prior to presenting the system to the Owner for acceptance.

B. At project closeout, provide the Owner with two (2) extra sets of filters for all equipment utilizing air filter media installed as part of this project.

1.13 FINAL REQUIREMENTS

A. Materials, fittings, apparatus, fixtures, etc., not particularly specified or shown on plans but necessary to provide a first class mechanical system for the building, must be furnished notwithstanding such omission.

B. Oil from mechanical system must not be allowed to enter the boilers; the water must be drained by the Mechanical Contractor until all parts are free from oil, dirt or other foreign matter before returning to the boiler.

C. At the completion of the work, the entire plant must be delivered to the Owner in perfect working order with all joints tight, valves packed and adjusted.

D. All air handling equipment shall be thoroughly cleaned on both the inside and outside of the unit casing with all coils thoroughly cleaned prior to presenting the system to the Owner for acceptance.

E. Balance the entire air system to deliver and exhaust air quantities as designated, with allowable error of plus or minus 5%. Submit to the Engineer in triplicate, complete air and water balancing data sheets as hereinafter specified.

F. All tests and trials of the entire system requested or directed by the Engineer must be made by the Mechanical Contractor free of charge before acceptance of the work.

1.14 OWNER TRAINING

A. Upon completion of the installation, but before final acceptance of the system, the Mechanical Contractor shall be responsible for coordinating and scheduling training for the Owner on the care and operation of all parts of the system. Training may be conducted by the Mechanical Contractor only if he has certified training from the equipment manufacturers to do so. Otherwise, specific equipment training shall be conducted by the equipment manufacturers.

B. Training shall cover all major equipment and systems including, but not limited to, boilers, chillers, condensing units, pumps, air handling units, packaged rooftop units, dust collectors, heat pumps, energy recovery units, fans, valves, dampers, actuators, blower coil units, cabinet heaters, variable frequency drives, building automation system, etc.

1.15 GUARANTEE/WARRANTY

A. This Contractor guarantees all work, new material and apparatus to operate to the satisfaction of the Engineer for one (1) year from the final completion and acceptance of the system and must keep same in repair for said period, unless such defects are clearly the result of bad management after apparatus is out of his control.

B. The guarantee period shall start when the system has been accepted by the Engineer as being in working order.

C. All HVAC equipment shall be provided with a manufacturer’s warranty. Equipment warranties shall be effective from the date of substantial completion and acceptance and shall be a minimum of two (2) years unless otherwise indicated in the individual specification sections. This Contractor shall provide factory start-up services for all equipment when available from the equipment manufacturer.

D. Any exterior wall penetrations that leak within five (5) years after project substantial completion and acceptance shall be repaired and/or re-worked by the Mechanical Contractor at no additional cost to the Owner.

E. This Contractor guarantees the system to properly circulate hot water to all parts of the system.

F. The ventilating system shall be guaranteed to supply and exhaust the amounts of air as noted on the plans to within plus or minus 5%.

G. The temperature control system shall be guaranteed to maintain the temperatures at the instruments to within plus or minus one degree of their setting.

1.16 ALLOWANCES

A. The Mechanical Contractor shall include a $5,000 allowance for the installation of the gas utility service. The allowance shall include all costs, overhead, and taxes and shall be the actual cost from the utility to the contractor. If the allowance amount is more than the actual cost, the balance shall be deducted from the contract by change order. Likewise, any costs above the allowance shall be added to the contract by change order.

1.17 ALTERNATE BIDS

A. Alternate Bid H1

1. The Mechanical Contractor shall state the net addition to the base bid for the Tridium/Niagara Building Automation System specified in Sections 25 09 00 and 25 09 93 as installed by KLPD with ABB Controls. The base bid shall include the work specified in Divisions 23 and 24 only.

B. Alternate Bid H2

1. The Mechanical Contractor shall state the net addition to the base bid for the Tridium/Niagara Building Automation System specified in Sections 25 09 00 and 25 09 93 as installed by Masters' Building Solutions with Alerton Controls. The base bid shall include the work specified in Divisions 23 and 24 only.

C. Alternate Bid H3

1. The Mechanical Contractor shall state the net addition to the base bid for the Tridium/Niagara Building Automation System specified in Sections 25 09 00 and 25 09 93 as installed by Control Works, Inc. with Honeywell Controls. The base bid shall include the work specified in Divisions 23 and 24 only.

D. Alternate Bid H4

1. The Mechanical Contractor shall state the net addition to the base bid for the Tridium/Niagara Building Automation System specified in Sections 25 09 00 and 25 09 93 as installed by HVA Products with Johnson F-Ex Controls. The base bid shall include the work specified in Divisions 23 and 24 only.

E. Alternate Bid H5

1. The Mechanical Contractor shall state the net addition to or deduction from the base bid for furnishing and installing Daikin air handling unit and/or condensing unit in lieu of the manufacturers as called out in Section 23 72 05 and 23 73 13.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 EQUIPMENT SUPPORTS

A. General:

1. Furnish and install all equipment supports as indicated or required for the installation of all mechanical equipment, including miscellaneous upper steel as required to frame into overhead construction for distribution of weight.

2. All equipment supports shall incorporate anti-vibration isolation, hanger assemblies, concrete inserts, etc., as required.

3. Concrete anchors shall be installed in predrilled holes. “Shot-in” anchors will not be acceptable.

4. All concrete anchor inserts shall be metallic. Non-metallic inserts will not be acceptable.

5. Concrete inserts shall be furnished and located by the Mechanical Contractor and set by the Contractor responsible for pouring the concrete.

6. Wood screws or toggle bolts shall be used for mounting equipment in frame construction.

7. Mechanical equipment shall not support or be supported by any active piping or ductwork.

B. Concrete Pads:

1. Interior Concrete Equipment Pads:

a. Shall be a minimum of 3-1/2" thick unless indicated otherwise.

b. Shall be sized for a minimum overlap of 3" on the exterior dimension of the unit mounted thereon.

c. Concrete pads shall be furnished and installed by the Mechanical Contractor.

d. Furnish pads for all floor-mounted equipment as indicated on the equipment schedules.

e. Pads shall have a compressive strength of 4,000 psi, maximum water/cement ratio of 0.5, and maximum aggregate size of ¾”.

C. Steel Supports:

1. Steel supports in the form of pipe stands, rails, suspension frames, brackets, braces, etc., shall be furnished and installed for mechanical equipment indicated and/or required to have steel supports.

2. Shall be constructed to properly support and distribute the load.

3. Shall incorporate anti-vibration devices, anti-sway bracing, saddles and anchoring plates as required.

4. May be constructed of steel pipe, I-beams, channels, angle iron, or threaded steel rods.

5. All permanent supports shall be welded.

6. Support members which must be moved may be bolted or threaded pipe.

7. All threaded rods and bolts shall have nuts welded to rods, threads peened, or double nuts.

D. Roof Mounted Equipment:

1. Roof curbs and equipment support rails shall be sized and engineered to accommodate roof opening sizes, curb flanges of the equipment being mounted, as well as point-loading and structural support of all equipment.

2. Roof curbs and equipment support rails shall be constructed suitable to accommodate anchoring of the equipment being mounted with a minimum of 12” clearance from top of the roofing material to top of roof curb.

3. See Architectural plans for roof deck, type, pitch and insulation thickness.

4. Flashing and roof sealing of curbs and rails, including sealing of flashing flanges, cant strips, pitch seals at anchor bolts, etc., shall be by the Roofing Contractor.

5. Roof curbs shall be furnished and set in place by the Mechanical Contractor.

E. Finished Area Mechanical Equipment:

1. Wall and Floor Units:

a. Shall be set plumb and true.

b. Shall include all necessary flanges, trim strips, end closures, etc.

c. Shall be securely anchored in place.

d. Setting and anchoring shall be in accordance with manufacturers details and recommendations.

2. Finished Ceiling Mounted Units:

a. Shall have concealed steel supports as hereinbefore specified.

b. Flush and/or recessed equipment shall be supported from threaded hanger rods which can be drawn up to bring cabinet flush and/or tight to ceiling.

c. Recessed units shall be installed with recessing flanges furnished with the unit.

3.2 EQUIPMENT LABELS

A. Secure equipment labels directly to equipment in a clearly visible location. For equipment in finished areas, label shall be on inside surface of access panel.

B. Label all new equipment with tag numbers as scheduled, existing equipment as called out on the plans, or per Owner's direction.

3.3 EQUIPMENT MARKERS

A. Install equipment markers on the ceiling grid directly below each terminal unit and as directed by the Owner.

3.4 PIPING AND DUCTWORK LABELING

A. Install pipe and duct markers every 20 ft. or less with directional flow arrow and proper marking. Application procedure shall be in accordance with manufacturer's recommendations. Markings shall be securely adhered to pipe, duct, or outer insulation jacket. Incomplete or partially attached markers will not be accepted.

B. Flow arrow tape on piping systems shall wrap completely around the pipe and overlap each end of the piping system label to secure the label in place.

3.5 VALVE IDENTIFICATION

A. Secure valve tags to valves with heavy brass wire.

3.6 SLEEVES, OPENINGS, CUTTING AND PATCHING

A. Provisions for openings (except pipe sleeves) but including chases, holes and clearance through walls, floors, roof, ceilings and partitions shall be made in advance of construction of such parts of the building. These openings will be provided by Others during the construction of the building, but it shall be the responsibility of the Mechanical Contractor to furnish the applicable contractor with all opening dimensions where required for installing the mechanical work. These dimensions shall size and locate the openings.

B. If the Mechanical Contractor should neglect to inform the other Contractors of his opening requirements before that portion of the building construction has been completed, the Mechanical Contractor shall cut his own openings and provide framings and lintels as required. Before cutting or drilling, he must obtain permission from the Engineer and he shall repair any

damage to his satisfaction. In event holes must be cut through reinforced concrete, drill carefully so as to avoid spalling and unnecessary damage or weakening of structural members. No chopping or breaking out permitted.

C. Precedence in installing equipment and piping in close quarters will be as determined by the Engineer but no contractor has exclusive right-of-way in installing his work.

D. Confer and cooperate with other Contractors and agree as to running of pipe lines and ducts subject to Engineer's approval.

E. The Mechanical Contractor shall be responsible for the water tightness of all openings through the roof, outside walls and equipment room floors required for the mechanical system. Wall openings in exterior walls for ductwork shall be completely and thoroughly packed, caulked, and flashed as required to ensure a watertight installation.

F. Pipe Sleeves:

1. The Mechanical Contractor shall furnish and install in place, pipe sleeves which shall be ½" larger in diameter than insulation on insulated pipe lines or ½" larger in diameter than the outside pipe diameter on uninsulated piping. The sleeves shall be of sufficient length to pass through the entire floor or wall construction. (In addition, where sleeves pass through equipment room floors, the top of the sleeves shall terminate at a minimum of 2" above the finished floor line.)

2. Where piping passes through floors, walls or decks of frame construction, sleeves shall be constructed of 22 gauge galvanized formed sheet steel. Piping passing through floors, walls or decks of masonry construction, shall have sleeves constructed of Schedule 40 wrought iron or steel pipe.

3. The Mechanical Contractor shall be responsible for the locating of all pipe sleeves.

4. Note:

   a. Sleeves are not required for holes drilled in masonry or concrete construction except in equipment room floors.

G. Duct Sleeves:

1. The Mechanical Contractor shall furnish and install in place in equipment room floors duct sleeves which shall be ½" larger in each dimension than insulation on insulated ducts or ½" larger in each dimension than the outside of the duct on uninsulated ducts. The sleeves shall be of sufficient length to pass through the entire floor construction. The top of the sleeves shall terminate at a minimum of 2" above the finished floor line. Sleeves shall be set in place before final floor topping is poured.

2. Sleeves shall be constructed of 16 gauge galvanized formed sheet steel.

3. The Mechanical Contractor shall be responsible for the locating of all duct sleeves.

3.7 PLUMBING CONNECTIONS

A. Plumbing Contractor:

1. Will provide drains and drain connections within 10 ft of each:

a. Air handling unit.

b. Room air conditioning units.

c. Point indicated for sealed combustion boilers.

B. Mechanical Contractor:

1. Shall make final connections from services provided by the Plumbing Contractor (see above) to all mechanical equipment.

3.8 GENERAL

A. Equipment Access:

1. Install all piping, conduit, ductwork, and accessories to permit access to equipment for maintenance. Coordinate the exact location of wall and ceiling access panels and doors with other trades, making sure that access is available for all equipment and specialties.

B. Coordination

1. Verify that all devices are compatible for the surfaces on which they will be used. This includes, but is not limited to, diffusers, register, grilles, and recessed or semi-recessed heating and/or cooling terminal units installed in/on architectural surfaces.

2. Coordinate all work with other contractors prior to installation. Any installed work that is not coordinated and that interferes with other contractor's work shall be removed or relocated at the installing contractor's expense.

3. The Mechanical Contractor shall coordinate the installation of the gas meter and confirm gas pressure with the utility responsible for gas service to the building.

4. Cooperate with the test and balance agency in ensuring Section 24 05 00 specification compliance. Verify system completion to the test and balance agency (flushing, pressure testing, chemical treatment, filling of liquid systems, proper pressurization and air venting of hydronic systems, clean filters, clean strainers, duct and pipe systems cleaned, controls adjusted and calibrated, controls cycled through their sequences, etc.) ready for testing, adjusting and balancing work. Demonstrate the starting, interlocking and control features of each system so the test and balance agency can perform its work.

5. Install dampers, shut off and balancing valves, flow measuring devices, gauges, temperature controls, etc., required for functional and balanced systems.

6. Coordinate with the BAS Contractor to locate and install piping thermowells for temperature sensors, pressure sensors, flow meters, etc. Install all duct-mounted control dampers furnished by the BAS Contractor at locations shown on the plans.

C. Lubrication

1. Lubricate all bearings with lubricant as recommended by the manufacturer before the equipment is operated for any reason. Once the equipment has been run, maintain lubrication in accordance with the manufacturer's instructions until the work is accepted by the Owner. Maintain a log of all lubricants used and frequency of lubrication; include this information in the Operating and Maintenance Manuals at the completion of the project.

END SECTION 23 05 00

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SECTION 23 05 12 - HANGERS, SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the contract, including General and Supplementary Conditions and Division 01 specification sections apply to work of this Section.

1.2 RELATED WORK

A. 23 07 00 HVAC Insulation

1.3 QUALITY ASSURANCE

A. Substitution of Materials: Refer to General Conditions of the Contract.

1.4 SHOP DRAWINGS

A. Include dimensions, capacities, materials of construction, weights, wiring diagrams and appropriate identification for all equipment in this Section.

1.5 DESIGN CRITERIA

A. Constructed in accordance with ASME.

PART 2 - PRODUCTS

2.1 GENERAL

A. Mechanical Contractor shall furnish all concrete inserts, expansion shields, hanger rods, beam clamps, etc., as required for support of all piping installed by him.

B. Beam clamps shall be forged steel concentric loaded type with tie rod to lock clamp in place for all piping 5” through 8”.

C. C type clamps may be used for piping smaller than 5”.

D. Pipe support brackets and trapeze type hangers for piping shall be fabricated by the Mechanical Contractor.

E. All threaded support rod and bolts shall have either nuts welded to rods, threads peened or otherwise upset, or a double set of nuts to prevent unthreading of nuts.

F. All hanging equipment shall be suitable for piping supported.

G. Furnish Grinnell pipe covering protection saddles at all hanger and roof support locations on insulated hot piping 1-1/2” and larger.

H. Furnish Grinnell Fig. 167 protection shields at all hanger and roof support locations on insulated piping smaller than 1-1/2”.

I. Furnish Grinnell Fig. 167 protection shields at all hanger and roof support locations on piping insulated with vapor barrier pipe covering.

2.2 PIPE HANGERS

A. Manufacturers: B-Line, Fee and Mason, Anvil International, FNW, Unistrut or approved equal. Grinnell figure numbers are listed below; equivalent material by other manufacturers is acceptable.

B. Furnish Grinnell Fig. 260 clevis type pipe hangers for all piping unless otherwise indicated.

C. Furnish Grinnell copper plated Fig CT-65 light duty adjustable wrought clevis copper tubing hangers for uninsulated copper tubing.

D. Furnish Grinnell Fig. 261 riser clamps to support vertical piping where required.

2.3 PIPE, DUCT OR EQUIPMENT ROOF AND GRADE SUPPORTS

A. Manufacturers: Dura-Blok, Empire Industries, FNW, Haydon Corp., Miro Industries, Roof Top BLOX, or equal.

B. Furnish rubber support blocks with top channel. Channel to be secured to the tray with through bolts. Furnish with threaded rods as required to elevate piping, ductwork, or equipment a minimum of 18” above the roof or grade surface.

C. Install supports in accordance with manufacturers recommendations. Support spacing shall be as required to properly support the weight of the piping, equipment or ductwork (a maximum of 10’ spacing) shown without resulting in damage to the roofing material. Coordinate exact requirements with the Roofing Contractor.

2.4 PREFAB INSULATED ROOF CURBS

A. Manufacturers: Pate, ThyCurb, Vent Products, or equal.

B. Furnish for each duct penetration through roof.

C. Curbs shall be engineered and sized by the manufacturer for the equipment being supported. Each complete with minimum 18 gauge galvanized steel construction, continuous mitered and welded corner seams, integral base plate and factory installed wood nailer.

D. Factory insulated with 1-1/2" thick, 3 lb. density rigid fiberglass insulation with built-in cant for roof as required.

E. See architectural plans for roof deck type, pitch and insulation thickness. Curbs shall be minimum 18” high regardless of insulation thickness.

2.5 SUPPORT RAILS

A. Manufacturers: Pate, ThyBar, Vent Products, or equal.

B. Furnish for roof-mounted equipment, piping or ductwork as indicated on the drawings.

C. Rails shall be engineered and sized by the manufacturer for the equipment being supported, including any, and all, seismic and/or wind load requirements. Each complete with minimum 18-gauge galvanized steel construction with integral base plate, continuous welded corner seams, factory installed wood nailer, counter flashing with lag screws and built in cant for roof as required.

D. See Architectural plans or visit the site for roof deck type, pitch and insulation thickness. Rails shall be minimum 18” high regardless of insulation thickness.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Support all piping neatly and in an approved manner to allow for expansion, contraction and vibration. Piping shall be supported not more than 10 ft. between hangers and closer where required to prevent sagging or where required by local code, ordinance or the International Fuel Gas Code.

B. On hot piping, the hanger may be secured directly to the pipe and the pipe insulation surround the hanger. On all cold piping with vapor barrier insulation, the hanger shall surround the outside of the pipe insulation and sheet metal protection shields specified.

C. Piping shall be anchored where indicated or required. Submit anchor drawings to the Architect for approval when directed.

D. For piping routed through pool areas or pool equipment rooms or where a potentially caustic environment is involved, all hangers shall be 316L stainless steel.

3.2 PIPE, DUCT OR EQUIPMENT ROOF AND GRADE SUPPORTS

A. Support blocks for small equipment, piping, or ductwork shall be rubber support blocks with top channel where specifically indicated. Channel shall be secured to the tray with through bolts.

B. Piping and ductwork run on the roof or at grade shall be installed such that there is a minimum of eighteen inches (18”) of clearance from the top of the roof or grade surface to the bottom of the pipe/duct or pipe/duct insulation surface unless called out differently on the plans and/or details.

3.3 PREFAB INSULATED ROOF CURBS

A. Install roof curbs where ducts pass through roof. This contractor shall furnish the General Contractor with complete roof curb dimensions. Roof curbs shall be furnished and set in place by the Mechanical Contractor.

3.4 SUPPORT RAILS

A. Install support rails to support roof-mounted equipment, piping or ductwork as indicated. This contractor shall furnish the General Contractor with complete rail dimensions. See Architectural plans or visit the site for roof deck type, pitch and insulation thickness. Equipment support rails shall be furnished by the Mechanical Contractor and installed by the General Contractor.

END SECTION 23 05 12

SECTION 23 05 13 - MOTORS AND STARTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the contract, including General and Supplementary Conditions and Division 01 specification sections apply to work of this Section.

1.2 RELATED WORK

A. 23 05 14 Variable Frequency Drives

B. 26 00 00 Electrical for Power Wiring

1.3 QUALITY ASSURANCE

A. Substitution of Materials: Refer to General Conditions of the Contract.

1.4 SHOP DRAWINGS

A. Include dimensions, capacities, materials of construction, weights, wiring diagrams and appropriate identification for all equipment in this Section.

1.5 REFERENCE STANDARDS

A. ANSI/IEEE 112 - Test Procedure for Polyphase Induction Motors and Generators

B. Constructed in accordance with ASME

C. ANSI/ NEMA MG-1 - Motors and Generators

D. ANSI/NFPA 70 - National Electrical Code

E. IECC 2015 with Wisconsin amendments (SPS 363)

PART 2 - PRODUCTS

2.1 MOTOR REQUIREMENTS

A. All electric motors shall be NEMA standard motor sizes rated as indicated on the motor starter schedule.

B. All electronically commutated (EC) motors shall be complete with integral potentiometer, motor power input wire whip, and motor control input wire whip for 0-10 VDC control signal.

C. All motors 1 HP and larger shall meet or exceed requirements of ASHRAE 90.1.

D. All motors 1-1/2 HP and larger shall meet or exceed local utility requirements for premium efficiency motors. Mechanical Contractor shall verify current requirements with utility.

E. All motors used on variable frequency drives shall be premium efficiency inverter-duty type and must be suitable for use with the drive, including but not limited to shaft grounding rings and motor cooling.

2.2 STARTING EQUIPMENT

A. Manufacturers: Allen-Bradley, Cutler Hammer, Eaton, Johnson Controls, Square D, General Electric, Franklin Control Systems, Taco, or ABB Control Inc.

B. All starters shall be NEMA standard sizes and all starting equipment shall be of the same manufacturer.

C. All starters, pushbuttons and selector switches shall have NEMA Type 1 enclosures.

2.3 STARTERS

A. All manual starters shall be two pole for single phase fractional horsepower service with lockable on-off switch, hand-off-auto, power-run-fault indication lights, electronic overload protection, control system contacts, auxiliary dry contacts, manual-auto reset selection, fault relay, status relay, and power failure return mode. Franklin BAS-1P, Johnson Controls BMMS-1P, Taco T1P, or approved equal.

B. Except where indicated otherwise, all magnetic starters shall be combination type with circuit breaker across the line for three phase service with reset button in cover, pilot light, overload protection for each phase, undervoltage protection, missing phase protection, phase reversal, built-in control circuit transformer with 120 volt operating coils and hand-off-auto selector switch factory mounted in starter flange.

C. All starters shall be equipped with auxiliary contacts or control relays for equipment control interlocking as required.

PART 3 - EXECUTION

3.1 MECHANICAL CONTRACTOR

A. Shall furnish all starting equipment including selector switches, relays, etc. He shall turn all manual and magnetic starters over to the Electrical Contractor with complete instructions and wiring diagrams required for a complete installation. All other control equipment shall be turned over to the BAS Contractor for installation.

B. Verify final locations with the Owner and the Electrical Contractor.

C. Shall furnish all fused and/or circuit breaker disconnects as required if not furnished with the equipment and turn over to the Electrical Contractor for installation.

D. Shall furnish and install all control wiring.

E. Shall confirm voltage requirements with the Electrical Contractor prior to ordering equipment.

3.2 ELECTRICAL CONTRACTOR

A. Will install all fused and/or circuit breaker disconnect switches that are furnished with mechanical equipment or by the Mechanical Contractor. Electrical Contractor shall coordinate exact requirements with the Mechanical Contractor and the actual equipment furnished.

B. Will furnish and install all power wiring from panel board to motors and junction boxes in factory-assembled units.

C. Will install all starters in cooperation with and under the supervision of the Mechanical Contractor.

END SECTION 23 05 13

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SECTION 23 05 14 - VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the contract, including General and Supplementary Conditions and Division 01 specification sections apply to work of this Section.

1.2 RELATED WORK

A. 23 05 13 Motors and Starters

B. 25 09 00 Building Automation System

C. 26 00 00 Electrical

1.3 QUALITY ASSURANCE

A. Substitution of Materials: Refer to General Conditions of the Contract.

1.4 SHOP DRAWINGS

A. Include dimensions, capacities, materials of construction, weights, wiring diagrams and appropriate identification for all equipment in this Section.

1.5 DESIGN CRITERIA

A. Constructed in accordance with ASME, ANSI, NFPA 70, National Electrical Code.

B. Harmonic Distortion:

1. The adjustable frequency drive systems shall operate satisfactorily when connected to a bus supplying other solid state power conversion equipment which may be causing up to 10 percent total harmonic voltage distortion and commutation notches up to 36,500 volt microseconds, or when operated from the same bus.

2. Individual or simultaneous operation of the adjustable frequency drive systems shall not add more than 5 percent total harmonic voltage distortion to the normal bus, nor more than 10 percent while operating from the standby generator in accordance with IEEE 519, Latest Edition.

3. Maximum total and individual harmonic current distortion limits for each odd harmonic shall not exceed those set forth by IEEE 519, Latest Edition.

4. If harmonic filters or reactors are needed to meet these requirements, then the manufacturer shall provide and be responsible for the design and manufacture of these items.

PART 2 - PRODUCTS

2.1 VARIABLE FREQUENCY DRIVES

A. Manufacturers: ABB, Danfoss, Eaton, Emerson, Franklin Control Systems, Yaskawa, General Electric or Square D.

B. For motors as indicated on the Variable Frequency Drive schedule on the drawings.

C. Inverters shall be PM compatible where required for electronically commutated (EC) motors.

D. Variable frequency systems to convert the unit fan motor and/or pump motor constant 60 hertz frequency to variable speed operation with the use of adjustable frequency inverters and the necessary hardware to provide the function as herein specified.

E. Inverters are to be mounted in a NEMA 1 type enclosure.

F. The following equipment and features are to be incorporated in each unit:

1. Minimum and maximum speed adjustments. Minimum speed is to be adjustable to 1/3 of maximum speed.

2. Adjustable linear acceleration and deceleration each separately adjustable effective during manual and automatic modes of operation.

3. Adjustable current limit.

4. Dual thermal overloads.

5. Inherent short circuit protection and ground fault protection. Rating shall be minimum 10 kA or as required by the local utility and electrical codes.

6. Automatic operation from a remote 4-20 ma input signal or a 0-10 volt signal.

7. BACnet integration card.

8. Under-voltage and over-voltage protection and single phase protection.

9. Over-temperature protection.

10. Rated to provide 110% of rated current for a minimum period of one minute.

11. Five percent (5%) chokes on input line and DC bus choke which will prevent damaging spikes from the transformer or from power outages.

12. Inverter is to be rated for an input power to +10% and -10%.

13. Door-interlocked fused disconnect.

14. Multi line LCD display for operating status, programming and fault history.

15. The following door mounted devices:

    a. Power “on” light.

    b. Digital readout for speed, load, and input KW, and faults.

    c. Manual/off/automatic selector switch.

    d. Manual speed potentiometer or keypad adjustment for operation in the manual-normal mode.

    e. Diagnostic readouts.

16. Floor stand mounting kit for free standing installation if field conditions require.

G. All components shall be pre-mounted and wired in a single enclosure. Each inverter and any associated hardware shall receive a minimum 20-40 minute “burn-in” high temperature test period under full load in conjunction with a certified statement which indicates that all components of the unit have been tested prior to assembly. A full 3 year warranty on all parts and labor must be provided.

H. A field service engineer of the drive manufacturer is to be provided for a minimum of 8 hours for start-up assistance and training.

PART 3 - EXECUTION

3.1 GENERAL

A. Variable frequency drives shall be installed in accordance with manufacturers instructions, where indicated on the drawings. Install units to allow adequate room for service.

B. Verify final locations with the Owner and the Electrical Contractor.

C. All variable frequency drives shall be set in place by the Mechanical Contractor and wired by the Electrical Contractor.

D. All power wiring to the unit shall be by the Electrical Contractor, all control wiring shall be by the BAS Contractor.

E. The manufacturers field service engineer shall record total harmonic distortion (THD) with the drives at 100% speed at time of start-up.

F. Provide separate conduits for input power, motor leads, and control wires.

END SECTION 23 05 14

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SECTION 23 05 15 - VIBRATION ISOLATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the contract, including General and Supplementary Conditions and Division 01 specification sections apply to work of this Section.

1.2 RELATED WORK

A. 23 20 10 HVAC Pumps

B. 23 62 13 Air Cooled CCU

C. 23 73 13 Air Handling Units

D. 23 34 00 Fans

1.3 QUALITY ASSURANCE

A. Substitution of Materials: Refer to General Conditions of the Contract.

1.4 SHOP DRAWINGS

A. Include dimensions, capacities, materials of construction, weights, wiring diagrams and appropriate identification for all equipment in this Section.

PART 2 - PRODUCTS

2.1 GENERAL

A. All mechanical equipment shall be mounted on vibration isolators, unless otherwise indicated on the schedules, to prevent the transmission of vibration and mechanically transmitted sound to the building structure. Vibration isolators shall be selected in accordance with the equipment weight distribution so as to produce uniform deflection and deflections shall be as noted on the equipment schedules. Isolators shall be furnished by the mechanical equipment manufacturers.

2.2 VIBRATION ISOLATORS

A. Manufacturers: Amber Booth, Korfund, Mason Industries, Peabody/Kinetics, Vibration Eliminator or Vibro Acoustics.

B. Mounting Types as follows:

1. Type B: Free-standing spring isolators, unhoused, with ¼" neoprene acoustical friction pads between baseplate and the support complete with leveling bolts bolted to the equipment. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Minimum additional travel to solid equal to 50% of the rated deflection.

2. Type C: Free-standing spring isolators with ¼" neoprene acoustical friction pads between baseplate and the support complete with leveling bolts bolted to the equipment. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Minimum additional travel to solid equal to 50% of the rated deflection. Furnish with a housing that includes vertical resilient limit stops to prevent spring extension when weight is removed. Housing shall serve as blocking during erection and the installed and operating heights shall be the same. Clearance shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action and limit stops shall be out of contact during normal operation. Outdoor mountings shall be hot dipped galvanized.

3. Type W: 5/16" thick neoprene waffle pad of durometer hardness required for equipment operating weight.

C. Bases:

1. Type IB: Rectangular structural channel concrete forms for floating foundations with Type B free standing springs as before specified. Bases for split case pumps shall be large enough to provide support for suction and discharge base ells. Channel depth shall be a minimum of $1/12^{th}$ of the longest dimension of the base but not less than 6". Forms shall include ½" reinforcing bars welded in place on 6" centers running both ways in a layer 1-1/2" above the bottom and drilled steel members with sleeves welded below the holes to receive the equipment anchor bolts. Height saving brackets shall be employed in all mounting locations.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all isolators for all equipment as indicated on the drawings as in accordance with manufacturers recommendations.

END SECTION 23 05 15

SECTION 23 05 16 - V-BELT DRIVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the contract, including General and Supplementary Conditions and Division 01 specification sections apply to work of this Section.

1.2 RELATED WORK

A. 23 72 05 Energy Recovery Units

1.3 QUALITY ASSURANCE

A. Substitution of Materials: Refer to General Conditions of the Contract.

1.4 SHOP DRAWINGS

A. Include dimensions, capacities, materials of construction, weights, wiring diagrams and appropriate identification for all equipment in this Section.

PART 2 - PRODUCTS

2.1 V-BELT DRIVES

A. Manufacturers: Browning or Woods.

B. Furnish for 7-1/2 HP and Smaller Motors:

1. Woods Type FHP or Browning Type LVP cast iron sheaves of size and number grooves required. Complete with adjustable flanges and locking devices.

C. Furnish for 10 HP through 30 HP Motors:

1. Woods Type SVS or Browning Type MVP cast iron sheave of size and number of grooves required. Complete with infinitely adjustable flanges and locking devices. All sheaves having 5 grooves or more shall be complete with companion sheaves with special wide groove spacing.

D. For all drives belt speed shall not exceed 5000 fpm, all sheaves shall be dynamically balanced, all sheaves shall be selected with a 1.5 minimum service factor and the center distances, arc of contact, ratio and belt type shall be as recommended by drive manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All sheaves shall be mounted on motors and fans and properly aligned in accordance with manufacturers instruction and belt installed with the tension as recommended.

END SECTION 23 05 16

SECTION 23 07 00 - HVAC INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the contract, including General and Supplementary Conditions and Division 01 specification sections apply to work of this Section.

1.2 RELATED WORK

A. 23 20 01 Pipe and Pipe Fittings

B. 23 31 00 Ductwork

1.3 QUALITY ASSURANCE

A. Substitution of Materials: Refer to General Conditions of the Contract.

1.4 SHOP DRAWINGS

A. Submit a schedule of all insulating materials to be used including adhesives, fastening methods, fitting material and intended use of each material. Include manufacturer's data sheets indicating density, thermal characteristics, jacket type and manufacturer's installation instructions.

1.5 DEFINITIONS

A. Concealed shall include shafts, furred spaces, space above finished ceilings, utility tunnels and crawl spaces. All other open areas shall be considered as exposed.

PART 2 - PRODUCTS

2.1 GENERAL

A. All insulation, facings, mastics and tapes installed within the building shall have a composite flame and smoke hazard rating as tested by procedure ASTM E-84-80, NFPA-255 and UL-723, not exceeding 25 flame spread or 50 smoke developed.

B. All insulation, facings, mastics, sealants and tapes shall be free of asbestos.

C. Duct insulation to be applied after duct tape and adhesive and/or duct sealant is applied by sheet metal contractor. Allow sufficient time for tape and adhesive to dry and/or duct sealant to cure before insulating ducts.

2.2 HOT PIPING

A. Type of piping and thickness:

1. Hot water supply and return piping (200 deg. F or less).

a. One and one-half inch (1-1/2") thickness on piping 1-1/2" and less.

b. Two-inch (2") thickness on piping 2" and larger.

c. Three-inch (3") thickness on all exterior piping.

2. Radiant floor tubing located above the floor or within walls.

a. One inch (1") thickness on all tubing.

3. Hot gas refrigerant piping.

a. One inch (1") thickness on all piping.

B. **Interior Piping:** Owens-Corning Fiberglass ASJ/SSL-II, Manville, Certainteed or Knauf fiberglass pipe insulation molded to conform to the pipe and split for application.

1. Minimum R=4 per inch thickness.

2. Complete with flame retardant kraft reinforced foil all service white jacket. Jacket shall have a factory applied double pressure sensitive adhesive to adhesive closure flap. Circumferential end joints shall be sealed with self-sealing 3" wide kraft reinforced foil white butt strips.

3. All valve bodies, flanges, clamp type pipe couplings and fittings shall be wrapped with pre-molded, one-piece 25/50 rated PVC insulated fitting covers. Factory pre-cut fiberglass insulation shall be applied to the fitting with the insulation tucked into the throat of the fitting and the edges of the adjacent pipe covering. The PVC cover shall be applied and secured by stapling and applying pressure sensitive tape over the staples and at the circumferential edges.

4. Vertical soft copper tubing concealed in building construction shall be covered with Armaflex AP, Aeroflex or Rubatex flexible, plenum rated, antimicrobial, closed cell elastomeric foam pipe insulation. All joints and seams are to be sealed with Armaflex 520 BLV low VOC adhesive or equal.

C. **Exterior Piping:** Armaflex AP, Aeroflex, or Aerofoam USA flexible, plenum rated, antimicrobial, closed cell elastomeric foam pipe insulation.

1. Minimum R=4 per inch thickness.

2. Insulation shall be slipped onto the pipe before it is connected, or it may be split lengthwise and installed over the piping.

3. Fittings, flanges, pipe couplings and valve bodies shall be covered using sheet insulation, of the same material and thickness as the surrounding pipe insulation, cut and formed to fit over the fitting or valve.

4. At each pipe hanger location, provide half-round, 6" long, hanger block at the bottom half of the piping in place of the pipe insulation. The hanger blocks shall be wood or asbestos free calcium silicate pipe insulation of the same thickness as the adjoining pipe insulation. The vapor barrier shall be continuous through the hanger location and a 16 gauge 12" long galvanized sheet steel saddle shall be wrapped around the pipe insulation between the jacket and the hanger.

5. All joints and seams are to be sealed with Armaflex 520 BLV low VOC adhesive or equal. Entire installation shall be vaporproof. Any breaks, rips, tears or omission of vapor barrier shall be repaired.

6. For pipe diameters 10" and larger, insulate piping with Dow Trymer 1800, or approved equal, polyisocyanurate rigid foam insulation in lieu of closed cell elastomeric foam pipe insulation.

2.3 HOT EQUIPMENT

A. Type of Equipment:

1. Magnetic Air and Dirt Separators.

B. One and one-half inch (1-1/2") thickness Owens-Corning Type 703, Manville, Certainteed or Knauf 3 lbs. per cu. ft. density fiberglass semi-rigid board insulation with factory applied aluminum foil reinforced kraft facing. Insulation shall be adhered to the surfaces with fire resistive adhesive (100% coverage). All edges and joints shall be sealed with 3" wide reinforced aluminum foil pressure sensitive joint sealing tape. All flaps shall be pasted and sealed with Benjamin-Foster No. 85-20 or Childers CP-82 fire resistive white adhesive.

2.4 COLD PIPING

A. Type of piping and thickness.

1. Refrigerant suction piping.

a. One and one-half inch (1-1/2") thickness on all piping.

B. **Interior Piping:** Owens-Corning Fiberglas ASJ/SSL-II, Manville, Certainteed or Knauf fiberglass pipe insulation, molded to conform to the pipe and split for application.

1. Minimum R=4 per inch thickness.

2. Complete with flame retardant kraft reinforced foil all service white vapor barrier jacket. Jacket shall have a factory applied double pressure sensitive adhesive to adhesive closure flap. Circumferential end joints shall be sealed with 3" wide self-sealing kraft reinforced foil vapor barrier white butt strips.

3. All valve bodies, flanges, clamp type pipe couplings and fittings shall be wrapped with pre-molded one-piece 25/50 rated PVC insulated fitting covers. Factory pre-cut fiberglass insulation shall be applied to the fitting with the insulation tucked into the throat of the fitting and the edges of the adjacent pipe covering. The PVC cover shall be applied and secured by stapling and applying vapor barrier pressure sensitive tape over the staples and at the circumferential edges. The tape shall have an overlap on itself of at least 2". All seam edges of the cover shall be sealed with vapor barrier adhesive.

4. At each pipe hanger location, provide half-round, 6" long, hanger block at the bottom half of the piping in place of the pipe insulation. The hanger blocks shall be wood or asbestos free calcium silicate pipe insulation of the same thickness as the adjoining pipe insulation. The vapor barrier jacket shall be continuous through the hanger location and a 16 gauge 12" long galvanized sheet steel saddle shall be wrapped around the pipe insulation between the jacket and the hanger.

5. Entire installation shall be vaporproof. Any breaks, rips, tears or omission of vapor barrier shall be repaired.

C. **Exterior Piping:** Armaflex AP, Aeroflex, or Aerofoam USA flexible, plenum rated, antimicrobial, closed cell elastomeric foam pipe insulation.

1. Minimum R=4 per inch thickness.

2. Insulation shall be slipped onto the pipe before it is connected, or it may be split lengthwise and installed over the piping.

3. Fittings, flanges, pipe couplings and valve bodies shall be covered using sheet insulation, of the same material and thickness as the surrounding pipe insulation, cut and formed to fit over the fitting or valve.

4. At each pipe hanger location, provide half-round, 6" long, hanger block at the bottom half of the piping in place of the pipe insulation. The hanger blocks shall be wood or asbestos free calcium silicate pipe insulation of the same thickness as the adjoining pipe insulation. The vapor barrier shall be continuous through the hanger location and a 16 gauge 12" long galvanized sheet steel saddle shall be wrapped around the pipe insulation between the jacket and the hanger.

5. All joints and seams are to be sealed with Armaflex 520 BLV low VOC adhesive or equal. Entire installation shall be vaporproof. Any breaks, rips, tears or omission of vapor barrier shall be repaired.

6. For pipe diameters 10" and larger, insulate piping with Dow Trymer 1800, or approved equal, polyisocyanurate rigid foam insulation in lieu of closed cell elastomeric foam pipe insulation.

2.5 COOLING COIL CONDENSATE DRAIN PIPING

A. Armaflex AP, Aeroflex, or Aerofoam USA flexible, plenum rated, antimicrobial, closed cell elastomeric foam pipe insulation.

B. One-half inch (1/2") thickness. Minimum R=4 per inch thickness.

C. Insulation to be slipped onto the pipe before it is connected or may be split lengthwise and installed over the piping.

D. Fittings, flanges, pipe couplings and valve bodies shall be covered using sheet insulation, of the same material and thickness as the surrounding pipe insulation, cut and formed to fit over the fitting or valve.

E. All joints and seams are to be sealed with Armaflex 520 BLV low VOC adhesive or equal. Entire installation shall be vapor proof. Any breaks, rips, tears or omission of vapor barrier shall be repaired.

2.6 VALVE COVERING

A. At contractor's option in lieu of standard pipe insulation, all control valves, isolation valves, and balancing valves may be wrapped with a removable and reusable valve wrap of thickness as required per code for the piping system served. Valve wrap shall consist of fiberglass insulation with DuPont Tychem QC stretchable, polyethylene-coated outer jacket with vapor barrier and a Velcro closure system. Valve wrap system shall have a 25/50 flame/smoke rating and non-combustible per ASTM 136. No Sweat Valve Wraps, or equal.

2.7 PIPING INSTALLED OUTSIDE OF THE BUILDING

A. Completely cover all pipe insulation installed outside of the building with white semi-gloss embossed or aluminum embossed, ultraviolet inhibited, outdoor grade, minimum 13 mil Venture Clad, Polyguard Alumaguard, or Knauf Redi-Clad pipe insulation with self-bonding, cold weather adhesive backing. End to end joints must be lapped a minimum of 2" for a watertight installation.

2.8 DUCTWORK

A. Type of ductwork and type of insulation:

1. All outside air intake ductwork. **Rigid Board**

2. All combustion air intake ductwork. **Duct Wrap**

3. All exhaust air ductwork from automatic exhaust air damper or self-acting damper to roof or wall termination except acoustically lined ductwork. **Rigid Board**

4. All mixed air ductwork. **Rigid Board**

5. All supply air ductwork from each air handling unit installed within the mechanical equipment room (except acoustically lined ductwork). **Rigid Board**

6. All supply air ductwork from each air handling unit installed outside of the mechanical equipment room (except ductwork exposed within an air conditioned space and acoustically lined ductwork). **Duct Wrap**

7. All outside air and exhaust air ductwork serving indoor energy recovery units and/or dedicated outside air units from the unit connection to the weatherproof louver or hood. **Rigid Board**

8. Ductwork as indicated. **Acoustic Wrap**

B. Rigid Board insulation:

1. Indoor ductwork: Minimum two-inch (2") thick Owens-Corning, Manville, Certainteed or Knauf fiberglass duct insulation with factory applied aluminum foil reinforced kraft vaporproof facing. The entire assembly shall provide a minimum "installed R value" of 6 for all indoor ductwork.

2. Outdoor ductwork: Minimum three-inch (3") thick Owens-Corning, Manville, Certainteed or Knauf fiberglass duct insulation with factory applied aluminum foil reinforced kraft vaporproof facing. The entire assembly shall provide a minimum "installed R value" of 12 for all outdoor ductwork.

3. Insulation shall cover all duct flanges for a smooth exterior finish.

4. The insulation shall be fastened to the duct with fire resistive adhesive (100% coverage) and Graham welding pins located on a maximum of 18" centers and not less than 3" from each edge or corner of the board. Stick-Klip fasteners may be used in lieu of welding pins providing they are installed in accordance with the manufacturer's recommendations on a clean surface with Type S adhesive.

C. Duct Wrap Insulation:

1. Minimum two-inch (2") thick Owens-Corning, Manville, Certainteed or Knauf fiberglass blanket type duct insulation with factory applied reinforced foil vapor barrier facing and a 2" stapling and taping flange.

2. Insulation shall be installed with facing outside so that tape flaps overlap at opposite end. Insulation shall be tightly butted. Seams shall be stapled 6" on center. Seal joints with pressure sensitive tape matching the facing.

3. Where rectangular or oval ducts are greater than 24" in width, insulation shall be secured to the bottom of the duct with mechanical fasteners spaced on 18" centers to prevent sagging of insulation.

4. Seal all tears, punctures and other penetrations of facing with tape or mastic to provide a vapor tight system installation.

5. The entire assembly shall provide a minimum "installed R value" of 6.

6. At contractor's option, RipplePak Insulapack insulating gas bubble-foil duct wrap insulation may be used in lieu of fiberglass duct wrap. Insulation thickness and/or number of layers shall be provided as required to meet the minimum "installed R value" requirement of 6. Verify with manufacturer's instructions with respect to mechanical fasteners.

2.9 DUCTWORK INSTALLED WITHIN SPACES CONTAINING MECHANICAL EQUIPMENT

A. Cover rigid board duct insulation installed within mechanical rooms with white semi-gloss embossed or aluminum embossed, minimum 13 mil Venture Clad, Polyguard Alumaguard, MFM Flex Clad or equal duct insulation covering with self-bonding, adhesive backing. End to end joints must be lapped a minimum of 2" for a watertight installation.

2.10 DUCTWORK FIREPROOFING

A. Furnish and install for all ductwork serving kitchen range hoods two layers of Thermal Ceramics FireMaster FastWrap XL, Pyroscat DuctWrap XL, Johns-Manville Firetemp, or equal fireproofing insulation. Insulation shall be UL Listed per ASTM E2336 to provide a 2-hour and zero clearance to combustible fire resistive enclosure around ductwork. Duct access doors and integral insulation cover shall be FireMaster FastDoor XL, or equivalent door UL Listed per UL1978 and ASTM E2336, and with liquid tight gasketing.

2.11 RIGID BOARD FOR RADIANT FLOOR HEATING SYSTEMS

A. For floor areas served by radiant floor heating systems, furnish and install 2" thick extruded polystyrene foam (XPS) rigid board insulation with an R value of 5 per inch of thickness.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Systems and/or equipment which is specified to be pressure tested or inspected shall not be insulated until testing and inspection has been successfully completed.

B. Duct wrap insulation shall be installed and secured to the ductwork to prevent any sagging in accordance with the manufacturer's installation instructions and recommendations.

C. Insulation jackets and accessories shall only be installed under ambient temperatures recommended by the manufacturer of the material.

D. Install insulation with smooth and even surfaces and on clean, dry surfaces. Poorly fitted joints or use of filler in voids will not be accepted. Use full length material wherever possible.

E. Ductwork fireproofing wrap shall be installed in accordance with all federal, state and local codes and shall extend a minimum of 18" above the roof deck within the fan curb base.

F. Coordinate the installation of the extruded polystyrene foam board insulation for tube fastening with the Mechanical Contractor and the Concrete Contractor prior to any floors being poured.

END SECTION 23 07 00

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SECTION 23 20 01 - PIPE AND PIPE FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the contract, including General and Supplementary Conditions and Division 01 specification sections apply to work of this Section.

1.2 REFERENCE STANDARDS

A. ANSI B16.5 - Pipe Flanges and Flanged Fittings

B. ASTM A53 - Pipe, Steel, Black & Hot Dipped, Zinc Coated Welded & Seamless

C. ASTM B75 - Seamless Copper Tube

D. ASTM B88 - Seamless Copper Water Tube

E. ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service

F. ASTM D2513 - Thermoplastic Gas Pressure Pipe, Tubing & Fittings

G. NFPA 54 – National Fuel Gas Code

1.3 QUALITY ASSURANCE

A. Order all Type E and Type S steel pipe with heat numbers rolled, stamped, or stenciled to each length or each bundle, depending on the size of the pipe, and in accordance with the appropriate ASTM specification.

B. All grooved joint couplings, fittings, valves and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

C. Order all copper water tube with each length marked with the name or trademark of the manufacturer and type of tube; with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier; all in accordance with ASTM B88.

D. Order all copper refrigeration tube with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier; with soft straight lengths or coils identified with a tag indicating that the product was manufactured in accordance with ASTM B280; and with each hard temper straight length identified throughout its length by a blue colored marking not less than 3/16 inch in height and a legend at intervals of not greater than three feet that includes the designation “ACR” and pipe outside diameter.

E. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

1.4 DESIGN CRITERIA

A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM specifications as listed in this specification.

B. Construct all piping for the highest pressures and temperatures in the respective system in accordance with ANSI B31, but not less than 150 PSIG unless specifically indicated otherwise.

C. Non-metallic piping will be acceptable only for the services indicated. It will not be acceptable in occupied spaces and ventilation plenum spaces, including plenum ceilings.

D. For all pipe sizes and materials, welded, threaded or soldered, use only long radius elbows having a centerline radius of 1.5 pipe diameters. Short radius elbows will not be allowed.

E. Where ASTM A53 type F pipe is specified, ASTM A53 grade A type E or S, or ASTM A53 grade B type E or S may be substituted at Contractor's option. Where ASTM A53 grade A pipe is specified, ASTM A53 grade B pipe may be substituted at Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially available.

F. Where ASTM B88, type L hard temper copper tubing is specified, ASTM B88, type K hard temper copper tubing may be substituted at Contractor's option.

1.5 WELDER QUALIFICATIONS

A. Welding procedures, welders, and welding operators for all building service piping to be in accordance with certified welding procedures of the National Certified Pipe Welding Bureau.

B. The Architect, Engineer or Owner reserves the right to test the work of any welder employed on the project, at the Contractor's expense. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project.

PART 2 - PRODUCTS

2.1 HEATING HOT WATER

A. Two inch (2") and Smaller: ASTM A53, type F, standard weight (Schedule 40) black steel pipe with ASTM A126/ANSI B16.4, Class 150, standard weight black malleable threaded fittings.

B. Two and one-half inch (2-1/2") and Larger: ASTM A53, standard weight (Schedule 40) black steel pipe with ASTM A234 grade WPB/ANSI B16.9 standard weight, ERW, carbon steel weld fittings.

C. Where vertical branch piping runs in general construction, provide single piece ASTM B-88 type "K" soft temper copper tubing. Wrought copper sweat fittings and silver soldered joints shall be used at connections to mains and to equipment.

D. The Contractor, at his option, may use ASTM B88 seamless, Type L, hard temper copper tube with ANSI B16.22 wrought copper solder-joint fittings or mechanical press couplings and fittings, Apollo Press, FNW, Viega or Nibco, in lieu of steel pipe for all hot water piping 3" and smaller.

E. The Contractor, at his option, may use ASTM A53, standard weight (Schedule 40) black steel pipe with ASTM A536, Grade 65-45-12 ductile iron fittings with installation-ready ends for all hot water piping 2" and smaller. Gaskets shall be grade "EHP" EPDM compound designed for operating temperatures between -30 degrees F and 250 degrees F. Steel bolts and nuts shall be zinc-electroplated per ASTM A449 and retainer teeth shall be 300 series stainless steel. Victaulic QVSD.

F. The Contractor, at his option, may use ASTM A53, Schedule 40 black steel pipe with mechanical grooved pipe connections for all hot water piping 2-1/2" and larger.

2.2 NATURAL GAS

A. Two inch (2") and Smaller: ASTM A53, type F, standard weight (Schedule 40) black steel pipe with ASTM A197/ANSI B16.3, Class 150 black malleable iron threaded fittings or ASTM A234 grade WPB/ANSI B16.9 standard weight, ERW, carbon steel weld fittings.

B. Two and one-half inch (2-1/2") and Larger: ASTM A53, standard weight black steel pipe with ASTM A234 grade WPB/ANSI B16.9 standard weight, ERW, carbon steel weld fittings.

C. The Contractor, at his option, may use a carbon steel, cold press system utilizing ASTM A53 Schedule 40 black steel piping rated for -40 degrees F to 180 degrees F at 125 psi. Viega MegaPress G or approved equal.

D. Gas piping systems that exceed 5 PSIG design pressure shall be fully welded construction on all pipe sizes.

E. Gas piping that is run within the building and ceiling plenum spaces shall be fully welded construction on all pipe sizes.

2.3 UNDERGROUND NATURAL GAS

A. Underground piping shall be precoated with 3M Co. "Scotchkote" 6233 Fusion-Bonded Epoxy Coating, or pre-approved equal. All fittings or welds shall be coated at the job site with compatible 3M Co. "Scotchkote" brand protective resin.

2.4 REFRIGERANT

A. ASTM B88 type L hard drawn copper tube, cleaned and capped in accordance with ASTM B280, and marked "ACR", with ANSI B16.22 wrought copper or forged brass solder-type fittings and long radius elbows.

2.5 DRAIN PIPING

A. ASTM A53 Schedule 40 galvanized steel pipe with ASTM A-47 Class 150 galvanized malleable iron screwed fitting. Galvanizing shall conform to ASTM A-153.

B. The Contractor, at his option, may use ASTM A312, Schedule 10S, stainless steel pipe with Vic-Press couplings and fittings.

C. The Contractor, at his option, may use ASTM B88 seamless, Type L, hard temper copper tube with ANSI B16.22 wrought copper solder-joint fittings or mechanical press couplings and fittings; Viega or Nibco.

2.6 AIR VENTS

A. ASTM B-88 type “L”, 1/2” nominal size copper tubing with wrought copper sweat fittings with silver soldered joints.

2.7 UNIONS AND FLANGES

A. Two inch (2”) and Smaller: ASTM A197/ANSI B16.3 malleable iron unions with brass seats. Use black malleable iron on black steel piping and galvanized malleable iron on galvanized steel piping. Use unions of a pressure class equal to or higher than that specified for the fittings of the respective piping service.

B. Two and one-half inch (2-1/2”) and Larger: ASTM A181 or A105, grade 1 hot forged steel flanges of threaded, welding neck, or slip-on pattern and of a pressure class compatible with that specified for valves, piping specialties and fittings of the respective piping service. Use raised face flanges ANSI B16.5 for mating with other raised face flanges or equipment with flat ring or full face gaskets. Use ANSI B16.1 flat face flanges with full face gaskets for mating with other flat face flanges on equipment. Gasket material to be non-asbestos and suitable for pressures and temperatures of the piping system.

2.8 MECHANICAL GROOVED PIPE CONNECTIONS

A. Manufacturers: Victaulic or Anvil Gruvlok.

B. Mechanical grooved pipe couplings and fittings may be used with steel pipe on the systems indicated. Either cut-groove or equivalent roll-groove products are acceptable providing the system temperature and pressure requirements are met. Where ductile iron fittings are indicated, they shall conform to ASTM A536. Where forged steel fittings are indicated, they shall conform to ASTM A234, Grade WPB. Where factory fabricated steel fittings are indicated, they shall conform to ASTM A53, type F in sizes ¾” through 1-1/2” and type E or S, grade B in sizes 2” through 20”. Do not use fabricated fittings where malleable iron or forged steel fittings are available. Gaskets in all cases shall be EPDM suitable for temperatures to 230 degrees F.

C. The entire grooved piping system shall be of a single manufacturer.

D. Fittings and couplings must be suitable for the temperature and pressure involved. In no case is the final system to have a pressure rating of less than 250 PSIG at the design temperature of the fluid.

E. Acceptable fittings and couplings are listed below, based on Victaulic. When used on galvanized piping, fittings and couplings shall be galvanized. When used on black steel piping, fittings and couplings shall have an enamel coating.

F. Couplings: Couplings shall consist of two ductile iron housing segments and shall conform to ASTM F1476 Standard Specification for the Performance of Gasketed Mechanical Couplings for Use In Piping Applications.

1. Rigid Type (Victaulic Style 107 or Style 07 Zero-Flex): Coupling housings shall be cast with offsetting, angle-pattern bolt pads to provide joint rigidity and support and hanging in accordance with ANSI B31.1 and B31.9.

2. Flexible Type (Victaulic Style 77 or 177): For use in locations where vibration attenuation and stress relief are required.

G. Flanges: Ductile iron Style 741 or W741 except at lug type butterfly valves where standard welding flanges shall be used.

H. Fittings: Ductile iron elbows and tees of the manufacturer's standard line may be used in all sizes. Bullhead tees will not be accepted. Factory fabricated steel fittings may be used in all sizes where fitting wall thickness conforms to standard weight pipe. Mechanical T Style 920/920N fittings with ductile iron housings may be used for up to 2" outlet size.

I. Expansion Joints: Credit for the inherent flexibility of mechanical grooved pipe connections when used for expansion joints may be allowed upon specific application by the Contractor. Request shall be made in writing and shall include service, location, line size, proposed application and supporting calculations for the intended service.

J. At Contractor's option, three grooved piping flexible type couplings may be used at pump connections in lieu of flexible connectors.

K. At Contractor's option, factory-fabricated grooved pipe headers, pump discharge drops, pump suction drops, and suction diffusers (VIPD Series 381) that comply with the pump piping details may be used in lieu of the individual components shown on the details.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove all foreign material from interior and exterior of pipe and fittings.

3.2 ERECTION

A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings or other details before installing piping.

B. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.

C. Mitered elbows, notched tees, bull-head tees, and orange peel reducers are not acceptable. On threaded piping, bushings are not acceptable.

D. Use long-radius elbows on all piping with the exception of Victaulic grooved piping system standard elbows as noted within the specifications above. For all other piping types including welded, soldered, or threaded, short radius elbows are not acceptable.

E. Offsets shall be achieved using 45-degree elbows whenever possible.

F. The use of back-to-back 90-degree elbows is not acceptable. All 90-degree elbows shall be separated by a minimum of five (5) pipe diameters of straight pipe run to not be considered as back-to-back elbows.

G. “Weldolets” and “Threadolets” may be used for branch takeoffs up to one-half (1/2) the diameter of the main. The use of “saddle taps” or “pulled tees” is not acceptable.

H. Install drain valves throughout the systems to permit complete drainage.

I. Install isolation valves in branch piping for all hydronic equipment including factory pre-piped equipment.

J. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.

K. Install all valves, control valves, and piping specialties, including items furnished by others, as specified and/or detailed. Make connections to all equipment installed by others where that equipment requires the piping services indicated in this section.

L. Caulk around all piping passing through all walls, ceilings and floors. For fire rated walls, use four-inch (4") thick mineral wool firestop safing insulation and fire-rated silicone foam sealant per plan detail. For non-rated walls fiberglass insulation may be used in lieu of mineral wool firestop safing insulation. For plenum walls, the penetration shall be treated as a one-hour fire rated wall.

M. Install manual air vents at all high points and at all drops in elevation within the hot water and chilled water systems.

N. Install a bronze coupler at all locations where copper and steel piping are to meet.

3.3 WELDED PIPE JOINTS

A. Make all welded joints by fusion welding in accordance with ASME Codes, ANSI B31, and State Codes where applicable.

B. Electrodes shall be Lincoln, or approved equal, with coating and diameter as recommended by the manufacturer for the type and thickness of work being done.

3.4 THREADED PIPE JOINTS

A. Use a thread lubricant or Teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

3.5 MECHANICAL GROOVED PIPE CONNECTIONS

A. Use pipe factory grooved in accordance with the coupling manufacturer's specifications or field grooved pipe in accordance with the same specifications using specially designed tools available for the application.

B. Lubricate pipe and coupling gasket, align pipe, and secure joint in accordance with the coupling manufacturer's specifications.

C. Support pipe as indicated in Section 23 05 12 of these specifications except as modified below. Support each horizontal pipe section at least once between couplings and whenever a change in direction of line flow takes place. Support vertical pipe at every other floor or every other pipe length, whichever is most frequent. Set the base of the riser or the base fitting on a pedestal or foundation.

D. Follow coupling manufacturer's installation recommendations if they are more stringent than the above requirements.

E. The gasket shall be molded and produced by the coupling manufacturer of an elastomer suitable for the intended service.

3.6 COPPER PIPE JOINTS

A. Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe surfaces. Clean fitting and tube with emery cloth or sandpaper. Remove residue from the cleaning operations, apply flux, and assemble joint. Use 95-5 solder or brazing to secure joint as specified for the specific piping service.

B. Follow mechanical press joint manufacturer's installation recommendations for installation of all mechanical press couplings and fittings.

3.7 HOT WATER

A. Run water mains level or pitch horizontal mains up 1 inch in 40 feet in the direction of flow. Install manual air vents at all high points where air may collect. If vent is not in an accessible location, extend air vent piping to the nearest code acceptable drain location with vent valve located at the drain.

B. Main branches and runouts to terminal equipment may be made at the side or bottom of the main provided that there are drain valves suitably located for complete system drainage and manual air vents are located as described above.

C. Connections at a main may be made with a tee and a 90 degree or 45 degree elbow.

D. Use a minimum of two elbows in each pipe line to a piece of terminal equipment to provide flexibility for expansion and contraction of the piping systems. Offset pipe connections at equipment to allow for service, such as removal of the terminal device.

E. Use eccentric fittings for changes in horizontal pipe sizes with the fittings installed for proper air venting. Concentric fittings may be used for changes in vertical pipe sizes.

3.8 NATURAL GAS

A. Pitch horizontal piping down 1" in 60 feet in the direction of flow. Install a 4" minimum depth dirt leg at the bottom of each vertical run and at each appliance. When installing mains and branches, cap gas tight each tee or pipe end which will not be immediately extended. All branch connections to the main shall be from the top or side of the main.

B. Do not install gas pipe below a building or its foundation.

C. Underground gas piping depth shall be per NFPA requirements and/or per local code requirements. At a minimum, underground gas piping shall be installed 18"-24" below grade level.

D. All joints in underground polyethylene gas pipe must be made by qualified personnel proficient in the joining methods of ASTM D2513 thermoplastic gas pressure pipe and polyethylene fittings. Do not install polyethylene gas pipe inside buildings.

E. Gas piping concealed within a wall or installed within a ventilation air plenum shall be seamless or welded construction only. Threaded or press-fit joints are not allowed.

F. If an above ground vent terminates in an area subject to snow accumulation, terminate the line at least five feet above grade.

G. Install a shut off valve at each appliance. Provide a valved connection at the main for equipment and appliances furnished by others.

H. Piping through a roof shall be run through an approved roof penetration with flashing and counter flashing.

I. Install two (2) vent lines from gas trains on each item of gas fired equipment to outdoor atmosphere. One valve sized vent line connected to the gas vent valve, the other vent line, ½" size, connected to the reference connections on each main and pilot gas pressure regulator and the high and low gas pressure switches and run to outdoor atmosphere. Each gas vent pipe shall be individually piped to outdoor atmosphere. Terminate gas vent piping at the building exterior with a screened vent cap.

J. Test gas piping and/or propane piping for leaks after fabrication as follows: Before appliances are connected, gas piping systems shall stand a pressure of at least 150% of the working pressure but not less than 100 pounds per square inch for a period of not less than 24 hours without a drop in pressure due to leakage. Equipment not rated to withstand the test pressure shall be isolated from the piping system under test. The piping shall be filled with air or inert gas. **Oxygen shall never be used.** The source of pressure shall be isolated before the pressure tests are made.

K. Paint all gas piping installed outdoors with rust resistive paint. Piping run on the building exterior walls shall match the color of the wall. Piping run on the roof shall be painted bright yellow.

3.9 COOLING COIL CONDENSATE (LOOP SEAL)

A. Trap each cooling coil drain pan connection with a trap seal of sufficient depth to prevent conditioned air from moving through the piping. Extend drain piping to nearest code approved drain location. Construct trap with plugged tee for cleanout purposes as detailed. Final loop seal dimensions to be determined by the equipment manufacturer.

3.10 REFRIGERANT

A. Refrigeration piping to be installed by firms who are experienced in installation of such piping and in accordance with the requirements of the Wisconsin Administrative Code Section Comm. 45.

B. All solder joints to be ASTM Grade 4 or 5 and have a melting point of approximately 1250 degrees F. Solder impurities shall not exceed 0.15%. Tubing to be new and delivered to the job site with the original mill end caps in place. Clean and polish all joints before soldering. Avoid prolonged heating and burning during soldering. Purge all lines with nitrogen during soldering. Provide manual shut-off and check valves as required.

C. Leak test the system by charging the system to a pressure of 10 PSIG with the same type of refrigerant that will be used in the system. Charge refrigerant into the system through a Sporlan catchall filter-drier. Increase pressure to 300 PSIG with dry nitrogen. Rap all joints with a mallet and check for leaks with an electric leak detector having a certified sensitivity of at least one ounce per year. Seal any leaks that may be found and retest.

D. After completion of the leak test, evacuate the system with a vacuum pump to 500 microns while the system ambient temperature is above 60°F. Charge refrigerant into the system to 0 PSIG, then repeat evacuation to 500 microns. Allow system to stand evacuated for at least 12 hours. If no noticeable rise in pressure occurs, the system may be charged. Charge system with new refrigerant through charging valve and filter-drier until bubbles disappear from liquid line sight glass while compressor is in operation.

3.11 UNIONS, FLANGES AND MECHANICAL GROOVED PIPE COUPLINGS

A. Install a union, flange or mechanical grooved pipe coupling as required, at each automatic control valve and at each piping specialty or piece of equipment which may require removal for maintenance, repair, or replacement. Where a valve is located at a piece of equipment, locate the flange or union connection on the equipment side of the valve. Concealed unions, flanges or mechanical grooved pipe couplings are not acceptable.

3.12 BOILER EXTERNAL PIPING HYDROSTATIC TEST

A. For purposes of hydrostatic testing, boiler external piping (new and existing) shall be as defined in ANSI B31.1, Power Piping, paragraph 100.1.2.A. Conduct test with Contractor supplied apparatus in accordance with ANSI B31.1, paragraph 137.1.1 and ASME Boiler and Pressure Vessel Code, Section 1, paragraph PG-99.

3.13 PIPING SYSTEM LEAK TESTS

A. Verify that the piping system being tested (new and existing piping) is fully connected to all components and that all equipment is properly installed, wired, and ready for operation. If required for the additional pressure load under test, provide temporary restraints at expansion joints or isolate them during the test.

B. Conduct pressure test with test medium of air or water. If leaks are found in areas of new piping, repair the area with new materials and repeat the test; caulking will not be acceptable. If leaks are found in areas of existing piping that was not revised as part of the project, the Mechanical Contractor shall inform the Owner and proceed with repairs after receiving Owner approval for additional costs.

C. Do not insulate pipe until it has been successfully tested.

D. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.

E. For air tests, gradually increase the pressure to not more than one half of the test pressure; then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. The piping system exclusive of possible localized instances at pump or valve packing shall show no evidence of leaking.

F. Measure natural gas system test pressure with a water manometer or an equivalent device calibrated in increments not greater than 0.1 inch water column. System will not be approved until it can be demonstrated that there is no measurable loss of test pressure during the test period.

G. All piping except high pressure steam and high pressure condensate shall be tested with 100 PSIG pressure for a minimum of 8 hours. High pressure steam and high pressure condensate shall be tested at 250 PSIG for 8 hours.

3.14 CLEANING

A. Glycol Systems:

1. The glycol system shall be cleaned in accordance with all requirements and recommendations of the glycol manufacturer.

2. Fill, vent and circulate the system at full system flow rate with the recommended cleaning solution for the recommended duration but not less than 24 hours.

3. After circulating, the system shall be drained completely, flushed, refilled and drained completely again. Before filling the system with the glycol solution, the system shall be verified and documented to be completely clean, all strainer baskets shall be removed, cleaned if required, and remounted. If the system is not yet clean, the Mechanical Contractor shall repeat the procedure until clean and provide documentation to show as such.

END SECTION 23 20 01

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SECTION 23 20 02 - HVAC VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the contract, including General and Supplementary Conditions and Division 01 specification sections apply to work of this Section.

1.2 RELATED WORK

A. 25 09 00 Building Automation System

1.3 QUALITY ASSURANCE

A. Substitution of Materials: Refer to General Conditions of the Contract.

1.4 SHOP DRAWINGS

A. Include dimensions, capacities, materials of construction, weights, wiring diagrams and appropriate identification for all equipment in this Section.

1.5 DESIGN CRITERIA

A. Where valves are specified for individual mechanical services (i.e., hot water heating, steam, etc.), all valves shall be of the same manufacturer.

B. Furnish valve handle extensions on all insulated piping.

PART 2 - PRODUCTS

2.1 HOT WATER VALVES

A. Manufacturers: Apollo Valve, Milwaukee Valve, Nexus, Nibco, FNW, Sharpe, Stockham, Anvil Gruvlok, Victaulic, or approved equal.

B. Ball Valves:

1. Two-inch (2”) and smaller: Complete with two-piece bronze body, full port, screwed or sweat connections, blowout-proof stem, zinc-plated steel nut and handle with polyvinyl handle cover, chrome plated brass ball, reinforced PTFE seats and RPTFE packing. All suitable for 600 PSI CWP and 150 PSI SWP. Temperature range shall be 0°F - 400°F.

2. For press-type valves: Complete with two-piece brass body, full port, chrome plated brass ball, blowout-proof brass stem, reinforced PTFE seats, EPDM seals, zinc-plated steel nut

and handle with polyvinyl handle cover. All suitable for minimum 250 PSI CWP and 250 PSI maximum operating pressure. Temperature range shall be 0°F - 250°F.

C. Butterfly Valves:

1. Two and one-half inch (2½") to 12": Complete with grooved ends or drilled and tapped lug style ductile iron body, extended neck for insulation, aluminum bronze or electroless nickel coated ductile iron disc, blow-out proof stainless steel stem, EPDM pressure-responsive seat or liner, stem, and body seals. All suitable for 200 PSI maximum working pressure and 250 deg. F maximum water temperature with bubble tight shut-off. Valves 6" and under shall have lever operators complete with position locking devices, position indicators and memory stop. 8" through 12" shall have enclosed worm gear and handwheel operators with memory stops and position indicators.

2. Where valves are required to have adjustable pressure type packing glands as required by ASME, valve body shall be carbon steel with PTFE seat material.

D. Globe Valves:

1. One-half inch (½") to 2": Complete with bronze body, bronze union bonnet and nut, renewable seat and PTFE disc, adjustable graphite stem packing, packing gland and malleable iron handwheel. All suitable for 300 PSI CWP and 150 PSI SWP. Valves shall have adjustable pressure type packing glands as required by ASME. Temperature range shall be -20°F - 400°F.

2. Two and one-half inch (2½") to 10": Complete with cast iron body, bolted bonnet, renewable seat and disc, packing, packing gland, flanged ends, brass stem, body gasket and handwheel. All suitable for 200 PSI CWP and 125 PSI SWP. Valves shall have adjustable pressure type packing glands as required by ASME. Temperature range shall be -20°F - 400°F.

E. Drain Valves:

1. Three-quarter inch (3/4"): Complete with two piece bronze body, screwed connections, lever operated handle and stop, chrome plated bronze ball, reinforced Teflon seats and Teflon packing. All suitable for 600 PSI CWP and 150 PSI SWP. Fitted with hose thread adaptor and cap.

F. Gauge Valves:

1. One-quarter inch (1/4"): Complete with bronze body, union bonnet, renewable seat and disc, packing, packing gland and handwheel. All suitable for 300 PSI CWP and 150 PSI SWP.

G. The use of factory fully pre-fabricated coil packs is not allowed.

2.2 CHECK VALVES

A. Manufacturers: Keckley, Nibco, Metraflex, Mueller, Muessco, Anvil Gruvlok, or Victaulic.

B. Two inch (2") and smaller, Nibco T-480, or equal ring silent check valve. Complete with bronze body, stainless-steel stem and spring, stainless steel seat and PTFE disc. All suitable for 250 PSI CWP and 125 PSI SWP. Temperature range shall be 0°F - 250°F.

C. Two and one-half inch (2½") to 10", Nibco W-960 or equal non-slam wafer type silent check valve. Complete with cast iron body, bronze seat with bronze disc, and 316 stainless-steel spring. All suitable for 400 PSI CWP. Temperature range shall be 0°F - 200°F.

2.3 CALIBRATED BALANCING VALVES

A. Manufacturers: Armstrong, Bell & Gossett, IMI Engineering, FlowCon, Hays Fluid Controls, Nexus, Nibco, Taco, Tour & Anderson, Anvil Gruvlok, or Victaulic.

B. Furnish valves with bronze body with brass ball, differential pressure taps, adjustment knob, indexing pointer and locking stops and positive shut-off. Internal seat rings, drain and purge connection and preformed polyurethane for valve body.

C. At Contractor's option, factory pre-set automatic flow control valves may be used in lieu of manual balancing valves. Y-type body shall include flow-control cartridge, ball valve, pressure/temperature ports, and union-end connection. Cartridge design shall consist of a brass, stainless steel, or elastomeric diaphragm and polyphenylsulfone orifice plate. Manufacturer shall offer optional valve body style that allows for flow-control cartridge change-out. Hays, IMI, or Griswold.

D. At Contractor's option for valves 2.5" and larger, combination butterfly/venturi type balancing valves with flanged connections and two pressure/temperature ports may be used in lieu of the ball-type specified above. Butterfly valve shall be nodular cast iron with EPDM rubber seat, aluminum-bronze disc, stainless steel shaft, EPDM rubber O-ring, copper bearing, PTFE bearing bushing, and nodular cast iron hand lever. Venturi shall be carbon steel casting ASTM A216 Grade WCB with an accuracy of +/- 3%. Valve shall be rated for ANSI 150 PSIG. PRO Hydronic Specialties CBVF Series or approved equal.

E. The use of a factory pre-set automatic flow control valve or combination type balancing/shutoff valve does not eliminate the requirement for separate isolation valves as shown on the plans and details.

F. The use of factory fully pre-fabricated coil packs is not allowed.

2.4 TRIPLE DUTY VALVES

A. Manufacturers: American Wheatley, Armstrong, Bell & Gossett, Taco, Anvil Gruvlok, or Victaulic.

B. Furnish valves with cast iron body, brass seat, bronze disc and stainless-steel spring and stem and brass readout valves.

C. Non-slam check valve with spring loaded soft seat disc.

D. Calibrated balancing valve.

E. Suitable for 175 PSIG.

F. Triple duty valves may only be used for pump fine balancing and shall not be a replacement of the butterfly isolation valve shown. Both butterfly valves shown in the detail must still be provided for pump isolation.

2.5 GAS VALVES

A. Manufacturers: Walworth, Homestead, Nordstrom or approved equal.

B. Two inch (2") and smaller lubricated plug valves complete with cast iron body, wrench operated and screwed ends suitable for 125 PSI service.

C. Two and one-half inch (2½") and larger lubricated plug valves with cast iron body, wrench operated and flanged ends suitable for 125 PSI service.

2.6 SOLENOID VALVES

A. Solenoid valves to be complete with stainless steel body, internal pilot operated, and two-way normally closed operation.

B. Valve shall be 24V DC.

C. Valve shall be UL 429 listed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Properly align piping before installation of valves in an upright position; operators installed below the valves will not be accepted.

B. Install all temperature control valves furnished by the BAS Contractor. Coordinate individual valves with the specific equipment served to ensure that the proper valves are installed for each piece of equipment.

C. Install drain valves throughout the systems to permit complete drainage.

D. Install isolation valves in branch piping for all hydronic equipment including factory pre-piped equipment.

E. Hot water coil isolation valves shall be installed in fully accessible locations. Locations shall also be easily reachable without the need for a ladder whenever possible.

F. When utilizing a triple duty valve at a pump discharge, the valve shall not be used for the primary balancing of any pump. See Section 24 05 00 for balancing requirements.

G. Install valves in strict accordance with valve manufacturer's installation recommendations. Do not support weight of piping system on valve ends.

H. Prior to flushing of piping systems, place all valves in the full-open position.

END SECTION 23 20 02

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SECTION 23 20 03 - RADIANT FLOOR HEATING SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General provisions of the contract, including General and Supplementary Conditions and Division 01 specification sections apply to work of this Section.

1.2 RELATED WORK

A. 23 20 01 Pipe and Pipe Fittings

B. 23 20 05 Water Specialties

1.3 REFERENCES

A. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing

B. ASTM F877 - Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems

C. ASTM F1960 Cold Expansion Fittings with PEX Pings for Use with Cross-linked Polyethylene (PEX) Tubing

D. ASTM 714 – Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.

E. ASTM D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

F. CSA-B137.5 - Cross-linked Polyethylene (PEX) Tubing Systems for Pressure Applications

G. DIN 4726 - German Standard for Plastic Piping Used in Warm Water Floor Heating Systems

1.4 SHOP DRAWINGS

A. Provide submittals and shop drawings in accordance with the General Requirements and as specified herein. Submit shop drawings indicating schematic layout of system, including equipment, critical dimensions and piping/slab penetration details as well as details for protecting exposed PEX piping.

B. Submit manufacturer's technical installation instructions.

C. Submit catalog data on all equipment, fittings, fasteners and associated items necessary for the installation of the piping and manifolds.

1.5 WARRANTY

A. The Radiant Floor Heating pipe manufacturer shall warrant the cross-linked polyethylene piping to be free from defects in material and workmanship for a period of twenty-five (25) years. Submitted Warranty documents must include a completed Site Inspection Report (SIR) in accordance with pipe manufacturer's installation recommendations. The design shall be approved either by submittal or stamped by a registered engineer as being complete and accurate.

B. Radiant tubing and distribution piping of Cross-linked Polyethylene PEX pipe and fittings shall be designed by the pipe/tubing manufacturer.

C. All manifolds and controls shall be warranted for 18 months and/or two heating seasons.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Rehau, Roth, Uponor, Watts Radiant, Viega, or approved equal.

2.2 PIPING

A. All radiant floor heating piping shall be high density cross-linked polyethylene (PEX) with an approved cell classification in accordance with ASTM D3350. Pipe shall conform to ASTM F876 and CSA B137.5 and be certified by CSA or equivalent testing organization.

B. Piping shall be rated for 100 PSIG gauge pressure at 180 deg. F temperature and 80 PSIG gauge pressure at 200 deg. F temperature.

C. Piping shall have a co-extruded oxygen diffusion barrier capable of limiting oxygen diffusion through the pipe to less than 0.10 mg/l/day at 104 deg. F (40 deg. C) water temperature, in accordance with DIN 4726.

D. The minimum bend radius for cold bending of the pipe shall be not less than five (5) times the outside diameter. Bends with a radius less than this shall require the use of a bending template as supplied by the pipe manufacturer, and/or hot air.

2.3 FITTINGS

A. Fittings shall be manufactured of dezincification-resistant brass and shall be supplied by the piping manufacturer as part of a proven cataloged system. Manifold fittings to be compression nut style with split compression ring.

B. Fittings shall be certified to ASTM F877 and CSA B137.5 as part of the manufacturer's PEX piping system. Pipe couplings embedded within the thermal mass shall be EVERLOC cold-expansion compression-sleeve fittings.

2.4 MANIFOLDS

A. Distribution manifolds shall be manufactured of brass or copper and be supplied by the piping manufacturer as a proven cataloged part of the manufacturer's system.

B. Where required by design, brass manifolds shall be equipped with visual flow gauges, balancing and isolation valves for each circuit, isolation valves and fill ports. Manifolds to be supplied completely assembled.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's published installation manual and/or published guidelines.

B. Coordinate the installation of the extruded polystyrene foam board insulation for tube fastening with the HVAC Insulation Subcontractor and the Concrete Contractor prior to any floors being poured. See Section 23 07 00 for insulation requirements.

C. Route piping in orderly manner, according to layout and spacing shown in approved submittal drawings. All notes on drawings shall be followed.

D. At connections and fittings, use a plastic pipe cutter to ensure square and clean cuts, and joint pipes immediately or cap ends or pipe to seal from contaminants. Where fittings are installed within the thermal mass, they shall be wrapped in chloride-free tape or sealed within a heat-shrink material approved by the manufacturer.

E. Pipe should be dispensed using a suitable uncoiling device. Remove all twists prior to securing pipe. Pipe must lay flat on an even plane. Finished grade of a thermal mass must be a minimum of 3/4" above the top of PEX heating pipes. Fasten piping at no more than 3 feet intervals, being careful not to twist the pipe. In thin concrete slabs, it may be necessary to secure piping every 2 feet. Use only fasteners supplied or approved by the manufacturer of the PEX pipe.

F. Piping that must pass through expansion joints shall be covered in protective polyethylene convoluted sleeving (flexible conduit) extending 15 inches on each side of the joint. Sleeving must be secured on pipe to prevent movement during installation of thermal mass.

G. Where piping exits the thermal mass, a protective sleeving conduit shall be placed around the pipe, with the sleeve extending a minimum of 6 inches into the floor and existing by a minimum of 6 inches. For penetrations at manifolds, use rigid PVC bend supports secured in place to prevent movement.

H. Where manifolds are installed more than 3’-0” above the finished floor surface, vertical tubing extending from the manifold down to the floor shall be secured to the wall structure in a neat and orderly fashion utilizing tubing clips or other manufacturer-approved support devices.

I. At the time of installation of each circuit of pipe, connect the pipe to the correct manifold outlet and record pipe length for balancing. If manifold is not installed, cap the end of the pipe and

label the pipe's circuit numbers along with S for supply and R for return. Connect pipes to manifold as soon as possible, and record circuit lengths. All circuits shall be labeled to indicate circuit length and serviced area.

J. The following precautions shall be taken:

1. In areas intended for carpet:

a. Notify carpet installer that radiant heating tubing has been installed.

b. Keep pipes 6 inches from all wall baseplates.

c. Install metal guards where pipe will pass through wall baseplates and where carpet tack strips will be installed.

2. In areas intended for hardwood flooring:

a. Notify the hardwood floor installer that radiant heating tubing has been installed.

b. Ensure that nailing areas for hardwood flooring, if nailing is required, are clearly marked and known to hardwood installers.

3. In areas where concrete anchors will be installed:

a. Notify the trade(s) installing anchors that radiant heating tubing has been installed.

b. Ensure that area where anchors can be installed are clearly marked and known to the applicable trade.

K. The heating system should not be put into operation until the poured concrete thermal mass has cured a minimum of 28 days, unless otherwise specified and approved by thermal mass supplier. If it is necessary to operate the heating system to prevent freezing, a maximum flow temperature of 72 deg. F must not be exceeded while the thermal mass is curing. After curing, gradually increase the flow temperature by no more than 10 deg. F each day until system reaches the required operating temperature.

3.2 FIELD QUALITY CONTROL

A. Filling, Testing and Balancing: Tests of hydronic heating systems shall comply with local codes, and, where required, shall be witnessed by the building official. (Reference BOCA, ICBO, SBCCI or the acceptable code body for the jurisdiction.)

B. Pressure gauges used must show pressure increments of 1 PSIG and should be located at or near the lowest points in the distribution system.

C. Air Test:

1. Charge the completed, yet unconcealed pipes with air. Do not exceed 150 PSIG. Use liquid gas detector or soap solution to check for leakage at manifold connections.

D. Water Test:

1. Purge all air from pipes. Charge the completed, yet unconcealed pipes with water. Take necessary precautions to prevent water from freezing. Check the system for leakage, especially at all pipe joints.

2. Perform a preliminary pressure test pressurizing the system to the greater of 1.5 times the maximum operating pressure or 100 psi for 30 minutes. As the piping expands, restore pressure, first at 10 minutes into the test and again at 20 minutes. At the end of the 30-minute preliminary test, pressure must not fall by more than 8 PSIG from the maximum, and there shall be no leakage.

3. After performing the preliminary test, perform the main pressure test immediately. The main pressure test shall last 2 hours. The test pressure should be restored and must not fall more than 3 PSIG after 2 hours. No leakage should be detected.

4. Pressure shall be maintained and monitored during installation of the thermal mass. If any leak is detected during installation of thermal mass, leak must be found immediately, and the area cleared for repair using manufacturer-approved repair coupling. Retest before covering repair.

5. Complete all inspection and test reports as supplied by the manufacturer of the system.

END SECTION 23 20 03

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SECTION 23 20 04 - PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the contract, including General and Supplementary Conditions and Division 01 specification sections apply to work of this Section.

1.2 RELATED WORK

A. 23 20 01 Pipe and Pipe Fittings

1.3 QUALITY ASSURANCE

A. Substitution of Materials: Refer to General Conditions of the Contract.

1.4 SHOP DRAWINGS

A. Include dimensions, capacities, materials of construction, weights, and appropriate identification for all equipment in this Section.

1.5 DESIGN CRITERIA

A. Constructed in accordance with ASME.

PART 2 - PRODUCTS

2.1 VIBRATION/FLEXIBLE CONNECTORS (BASE-MOUNTED PUMP CONNECTIONS)

A. Manufacturers: American Brass, Mason Industries, Metraflex or Twin City Hose.

B. Furnish stainless steel tubing and stainless-steel wire braid covering with 150 PSIG flanged connections for piping where indicated and as required by the equipment manufacturer. Connector shall be suitable for operation at pressure and temperature of system.

2.2 PIPE SEALS

A. Manufacturers: Thunderline Corp., Metraflex Metraseal, Proco, or approved equal.

B. Furnish modular wall and casing type seals. Furnish model LS-200C for 1” and smaller pipe, model LS-300C for 1-1/4” through 5” diameter pipe and model LS-400C for 6” and larger pipe.

C. Each seal shall consist of neoprene rubber sealing links, Cathodic type pressure plates constructed of aluminum and hard coated with bolts of cadmium plated steel. Seals shall be air and watertight.

2.3 THERMOMETERS

A. Manufacturers: Weiss, Miljoco, Trerice or U.S. Gauge.

B. Furnish industrial type thermometers with separable sockets and provide extension necks on thermometers and sockets for piping with 2" or thicker insulation.

C. Thermometers shall be the adjustable angle type with black cast aluminum case and frame front, clear glass window, red appearing mercury tubes and bright finished metal scales with black etched figures and graduations. For hot water piping provide a 9" scale with 30 deg. F to 240 deg. F range and for chilled and condenser water piping provide 12" scale with 30 deg. F to 130 deg. F range.

2.4 PRESSURE GAUGES

A. Manufacturers: Weiss, Miljoco, Trerice or U.S. Gauge.

B. Furnish gauges with a minimum face diameter of 4-1/2", with cast aluminum case with black finish and black finish case ring, white background and black figures on dial face, bronze bushing movement and for ranges as applicable.

2.5 PIPE CURB ASSEMBLIES

A. Manufacturers: Pate, Portals Plus, The Vault by RPH, or Vent Products.

B. Furnish each complete with galvanized steel insulated curb with integral baseplate, wood nailer, acrylic clad thermoplastic cover with graduated step boots with one boot for each pipe and stainless-steel clamps. See architectural plans for roof deck type, pitch and insulation thickness.

2.6 GAS PRESSURE REGULATORS

A. Manufacturer: Fisher, Itron, Rockwell, Sensus, or approved equal.

B. Furnish regulator of size and capacity as indicated on drawings complete with die-cast aluminum body, screwed connections, Buna N diaphragm and internal relief. The regulator shall be constructed for 125 PSIG working pressure.

PART 3 - EXECUTION

3.1 VIBRATION/FLEXIBLE CONNECTORS

A. Install where indicated and as detailed on the drawings in accordance with manufacturers recommendations.

3.2 PIPE SEALS

A. Install where indicated on the drawings. Pipe sleeves shall be set in walls, floors and ceilings and cemented in place to receive pipe and the link pipe seal. Installation shall be made in accordance with manufacturer's recommendations.

3.3 THERMOMETERS

A. Install where indicated and detailed on the drawings. Thermometer shall be readable by a person standing on the floor.

3.4 PRESSURE GAUGES

A. Install where indicated and detailed on the drawings. Install a dampering device at the inlet of the gauge. Gauges shall be readable by a person standing on the floor.

3.5 PIPE CURB ASSEMBLIES

A. Install for all piping passing through roof.

3.6 GAS PRESSURE REGULATORS

A. Install gas pressure regulators in accordance with manufacturer recommendations.

END SECTION 23 20 04

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SECTION 23 20 05 - WATER SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the contract, including General and Supplementary Conditions and Division 01 specification sections apply to work of this Section.

1.2 RELATED WORK

A. 23 20 01 Pipe and Pipe Fittings

1.3 QUALITY ASSURANCE

A. Substitution of Materials: Refer to General Conditions of the Contract.

1.4 SHOP DRAWINGS

A. Include dimensions, capacities, materials of construction, weights, wiring diagrams and appropriate identification for all equipment in this Section.

1.5 DESIGN CRITERIA

A. Constructed in accordance with ASME.

PART 2 - PRODUCTS

2.1 TANKS

A. Pressurized Expansion Tank:

1. Manufacturers: American Wheatley, Amtrol, Armstrong, Bell & Gossett, Delta, Flo Fab, Grundfos, John Wood, Niles, Taco or Wessels.

2. ASME stamped for 125 PSIG working pressure.

3. Vertical pressurized steel tank.

4. Each complete with replaceable heavy duty butyl rubber bladder, 1-1/2" system connection, 3/4" drain connection, charging valve connection and lifting ring and floor mounting skirt for vertical mounting.

2.2 MAGNETIC AIR AND DIRT SEPARATORS

A. Manufacturers: Amtrol, Bell & Gossett, Caleffi, Grundfos, Spirotherm, Taco, Wessels, or pre-approved equal.

B. Furnish in-line magnetic air and dirt separator of size indicated with steel body, stainless steel coalescing medium, bottom collection chamber, removable top air vent, side-tap hose connection, minimum 1" bottom blow-down tapping with ball valve, ASME constructed and stamped for 150 PSIG working pressure with flanged connections.

C. Magnetic rod insert for ferrous material removal.

D. Note: the use of a separate in-line magnetic ferrous material remover (full line size) with a standard air and dirt separator is acceptable. ADEY MagnaClean, or approved equal.

2.3 HIGH CAPACITY AUTOMATIC AIR VENT

A. Manufacturers: Armstrong, Bell & Gossett, Caleffi, Thrush or Taco.

B. Float actuated high-capacity air vent rated for 150 PSIG at a maximum temperature of 250 deg. F. Constructed of cast iron body and fitted with components of stainless steel, brass and EPDM.

2.4 MANUAL AIR VENTS

A. Manufacturers: Caleffi, Dole or approved equal.

B. Dole No. 9P coin valve manual air vent or No. 14A coin air valve assembly.

2.5 STRAINERS

A. Manufacturers: Armstrong, Hoffman, OC Keckley, Metraflex, Nibco, Sarco, Victaulic or Webster.

B. Furnish cast iron Y-type or basket type body as indicated with perforated monel or stainless-steel screen and blow off connection with brass plug. 2" and smaller with screwed connections and 2-1/2" and larger with flanged or grooved connections. All strainers rated for 125 PSIG service.

2.6 GLYCOL FEED SYSTEM

A. For each glycol system, provide an automatic glycol feed unit, Axiom SF100, or approved equal, with 55 gallon storage/mixing tank with cover, pump suction hose with inlet strainer, pressure pump with thermal cut-out, integral pressure switch, integral check valve, cord and plug for 120 volt power, pre-charged accumulator tank with EPDM diaphragm, manual diverter valve, adjustable pressure regulating valve with pressure gauge, low-level pump cut-out, alarm panel with contacts for remote monitoring by the BAS, and pump capable of delivering 1.0 gpm at 85 psig.

2.7 WATER/GLYCOL SOLUTION

A. Manufacturers: Dow Chemical Co., Houghton Chemical Corp., Interstate Chemical, LinkOne OneGuard, Rhomar Water Management, Union Carbide Corp, or Wausau Chemical.

B. For each hot water system, furnish and install sufficient propylene glycol to completely fill the system with a solution that results in a final concentration of 35% glycol in deionized water. Propylene glycol solution shall include corrosion inhibitors and anti-bacterial additives as approved by the Wisconsin Department of Natural Resources. The Mechanical Contractor is responsible for ensuring that all DNR requirements for this solution are met.

C. For glycol utilized in hot water heating systems, the glycol/water solution shall be fully compatible with the boiler heat exchanger materials. The Mechanical Contractor shall verify compatibility with the boiler manufacturer.

PART 3 - EXECUTION

3.1 TANKS

A. Floor supported tanks shall be installed where indicated and as detailed on the drawings. Mount floor supported tanks on concrete pads.

3.2 MAGNETIC AIR AND DIRT SEPARATORS

A. Install magnetic air and dirt separators where shown and as detailed on the drawings. Units to be mounted in piping or foot supported in accordance with manufacturer's recommendations. Furnish and install an isolation valve on each side of the separator for blowdown.

3.3 HIGH CAPACITY AUTOMATIC AIR VENTS

A. Install automatic air vent where indicated. Install ball valve to isolate air vent from system.

3.4 MANUAL AIR VENTS

A. Install manual air vents where indicated and required as detailed on the drawings.

B. Install manual air vents at all high points and at all drops in elevation within the hot water and chilled water systems for complete removal of air from the system. Manual air vents shall be installed in accessible locations.

3.5 STRAINERS

A. Install strainers where indicated and as detailed on the drawings.

B. Furnish and install upstream of the supply connection at all coils on air handling units, blower coil units, geothermal terminal heat pumps, and geothermal heat pump air handling units and DOAS units.

3.6 GLYCOL FEED SYSTEM

A. Install in accordance with manufacturers written installation instructions. Verify exact location with the Owner.

3.7 WATER/GLYCOL SOLUTION

A. Fill each system with a water/glycol solution in accordance with the glycol manufacturer's recommendations. Glycol shall be furnished as a pre-mixed solution or in 100% glycol containers to result in the specified final concentration of propylene glycol in deionized water. The Mechanical Contractor shall leave one full drum of unmixed glycol in the mechanical room near the fill point for future use.

END SECTION 23 20 05

SECTION 23 20 07 - REFRIGERANT SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the contract, including General and Supplementary Conditions and Division 01 specification sections apply to work of this Section.

1.2 RELATED WORK

A. 23 20 01 Pipe and Pipe Fittings

B. 23 62 13 Air Cooled Compressor Condensing Units

1.3 QUALITY ASSURANCE

A. Substitution of Materials: Refer to General Conditions of the Contract.

1.4 SHOP DRAWINGS

A. Include dimensions, capacities, materials of construction, weights, wiring diagrams and appropriate identification for all equipment in this Section.

1.5 DESIGN CRITERIA

A. Constructed in accordance with ASME.

PART 2 - PRODUCTS

2.1 REFRIGERANT SPECIALTIES

A. Manufacturers: Alco or Sporlan.

B. Furnish at each direct expansion coil liquid connection a thermostatic expansion valve with external equalizer, a solenoid liquid stop valve with 115 volt operating coil with manual stem, filter dryer and a moisture and liquid indicator.

C. At each compressor condensing unit furnish a double port sight glass with caps and a charging valve.

D. Furnish a pilot operated hot gas bypass valve and a solenoid valve.

E. Furnish complete charge of refrigerant of type indicated and oil for each system.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install expansion valves, solenoid valve, filter dryer, moisture and liquid indicator in piping at each direct expansion coil as indicated and detailed on the drawings.

B. Install double port sight glass and a charging valve at each compressor condensing unit.

C. Install a pilot opening hot gas bypass valve in the line run from the compressor hot gas discharge line to refrigerant line between expansion valve and direct expansion coil.

D. Install refrigerant and oil as required.

END SECTION 23 20 07

SECTION 23 20 08 - CHEMICAL WATER TREATMENT

PART 1 - GENERAL

1.1 RELATED DRAWINGS

A. Drawings and General Provisions of the contract, including General and Supplementary Conditions and Division 01 specifications apply to work of this Section.

1.2 RELATED WORK

A. 23 20 01 Pipe and Pipe Fittings

1.3 QUALITY ASSURANCE

A. Substitution of Materials: Refer to General Conditions of the Contract.

1.4 SHOP DRAWINGS

A. Include dimensions, capacities, materials of construction, weights, wiring diagrams and appropriate identification for all equipment in this Section.

1.5 DESIGN CRITERIA

A. Electrical components and work must be in accordance with National Electrical Codes.

PART 2 - PRODUCTS

2.1 COMPOUND FEEDERS

A. Manufacturers: HOH, John Wood, Griswold, or Vector.

B. Furnish a bypass type feeder with two gallon steel container with 4” wide removable course thread cover, ¾” inlet, outlet and drain fittings. Feeder shall be built for 200 PSIG working pressure.

C. The Mechanical Contractor shall be responsible for the initial treatment of the system.

PART 3 - EXECUTION

3.1 COMPOUND FEEDERS

A. Install feeders in piping for easy access where shown and as detailed on the drawings with the top of the feeder approximately 30" above finish floor.

B. Perform initial water testing and insertion of chemicals in systems. Submit report to Owner indicating testing lab used, initial test results, chemicals added (including volume) and final test results.

END SECTION 23 20 08

SECTION 23 20 10 - HVAC PUMPS

PART 1 - GENERAL

1.1 RELATED DRAWINGS

A. Drawings and General Provisions of the contract, including General and Supplementary Conditions and Division 01 specification sections apply to work of this Section.

1.2 RELATED WORK

A. 23 05 13 Motors and Starters

B. 23 05 14 Variable Frequency Drives

C. 23 05 15 Vibration Isolators

1.3 QUALITY ASSURANCE

A. Substitution of Materials: Refer to General Conditions of the Contract.

1.4 SHOP DRAWINGS

A. Include dimensions, capacities, materials of construction, weights, wiring diagrams and appropriate identification for all equipment in this Section.

1.5 DESIGN CRITERIA

A. Electrical components and work must be in accordance with National Electrical Codes.

PART 2 - PRODUCTS

2.1 GENERAL

A. Pump sizes, capacities, pressures and operating characteristics shall be as scheduled.

B. Provide all pumps with motors, impellers, drive assemblies, bearings, coupling guards and other accessories specified. Statically and dynamically balance all rotating parts.

C. Provide all base-mounted pumps and pumps controlled by variable frequency drives with shaft grounding rings.

D. Pump motors to be sized for non-overloading over the entire pump curve. Motors to be 1750 rpm unless otherwise scheduled.

E. Pumps serving water systems containing glycol shall be provided with glycol-rated seals.

F. Test all pumps before shipment. The manufacturer shall certify all pump ratings.

G. Pump selections shall not be made with the largest available impeller to achieve the scheduled operating conditions. The pump selected and submitted shall have the ability to receive a larger impeller (minimum 10% larger in diameter) in the event that field installed conditions require additional capacity.

H. Pump selections shall be such that the dead-head pressure condition is at least 15% higher than the system design head pressure scheduled.

I. All pumps shall meet Department of Energy pump standards and tested using the PEI_{CL} method. The pump nameplate shall bear the PEI_{CL} index. Pumps bearing only the PEI_{VL} index will not be allowed. Submittals for review shall clearly identify the PEI's index and affirm that the index meets all DOE pump standards.

2.2 BASE-MOUNTED PUMPS

A. Manufacturers: Armstrong, Aurora, Bell & Gossett, Flo Fab, Grundfos, Patterson, Taco, Thrush, or Wilo.

B. Furnish close coupled single suction centrifugal type with direct connected open drip-proof motor, enclosed type bronze impeller trimmed for the operation condition, internally self-flushing mechanical seals, stainless steel shaft sleeve, bronze fitted with cast iron pump body with bronze wearing rings, and suction and discharge gauge tappings.

C. Submit pump operating curves with shop drawings.

2.3 IN-LINE PUMPS

A. Manufacturers: Armstrong, Aurora, Bell & Gossett, Flo Fab, Grundfos, Patterson, Taco, Thrush, or Wilo.

B. Furnish pipe-line mounting type with flexible coupling connected, variable speed ECPM motor with coupling enclosure, enclosed bronze impeller trimmed for the operation condition, externally replaceable mechanical shaft seal, bronze fitted with cast iron pump body with bronze wearing rings and suction and discharge gauge tappings.

C. Submit pump operating curves with shop drawings.

2.4 SUCTION DIFFUSERS

A. Manufacturers: American Wheatley, Armstrong, Aurora, Bell & Gossett, Flo Fab, Grundfos, Patterson, Taco, Thrush, Wilo or Victaulic.

B. Furnish cast iron angle type body with steel inlet vanes, steel combination diffuser strainer and orifice plate and a number 16 mesh bronze start-up strainer, which is to be removed after initial 30-days of operation, an adjustable foot support to carry the weight of the suction piping and

inlet flange or gauge port pressure gauge tappings. Discharge pipe size of suction diffuser to be same size as pump inlet.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all pumps where indicated on the drawings and in strict accordance with manufacturers instructions. Service space around pumps shall not be less than minimum space recommended by pump manufacturer.

B. Set base-mounted pumps on 3-1/2” thick concrete pads as indicated and provide vibration isolators where indicated.

C. Decrease from line size at pump connections with suction diffusers where specified, long radius reducing elbows or concentric reducers/increasers in the vertical piping, and eccentric reducers/increasers for the horizontal piping. Install eccentric reducers/increasers with the top of the pipe level. For base-mounted pumps, provide supports for elbows on pump suction and discharge piping over 4” size.

D. All piping specialties and valves must be full line size as indicated on the drawings.

E. All base-mounted and inline pumps shall be installed with pressure gauges, gauge valves and associated piping across the pump as required for proper balancing and setup even if not shown on the detail.

F. Lubricate pumps before start-up.

END SECTION 23 20 10

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SECTION 23 31 00 - DUCTWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the contract, including General and Supplementary Conditions and Division 01 specification sections apply to work of this Section.

1.2 RELATED WORK

A. Section 23 33 07 Ductwork Accessories

1.3 QUALITY ASSURANCE

A. Substitution of Materials: Refer to General Conditions of the Contract.

1.4 SHOP DRAWINGS:

A. Include dimensions, capacities, materials of construction, weights, wiring diagrams and appropriate identification for all equipment in this Section.

1.5 REFERENCE STANDARDS

A. SMACNA

B. NFPA 90A Standards for the Installation of Air Conditioning and Ventilating Systems.

C. UL 181

1.6 DESIGN CRITERIA

A. Construct all ductwork to be free from vibration, chatter, objectionable pulsations and leakage under specified operating conditions.

B. Use material, weight, thickness, gauge, construction and installation methods as outlined in the following most current SMACNA publications:

1. HVAC Duct Construction Standards, Metal and Flexible.

2. HVAC Air Duct Leakage Test Manual.

3. HVAC Systems - Duct Design.

4. Rectangular Industrial Duct Construction Standard.

5. Round Industrial Duct Construction Standards.

6. Thermoplastic Duct (PVC) Construction Manual.

C. Use products which conform to NFPA 90A, possessing a flame spread rating of not over 25 and a smoke developed rating no higher than 50.

PART 2 - PRODUCTS

2.1 GENERAL

A. Ductwork, except as hereinafter noted otherwise, shall be minimum G-90 galvanized steel of lock forming grade conforming to ASTM Standards A-525 and A-527. Duct wall thicknesses, reinforcements, seams, joints, sealing, cross bracing, beading, hangers, supports, etc., shall be in accordance with the latest manual of heating, ventilating and air conditioning duct construction standards as published by the Sheet Metal and Air Conditioning Contractors National Assoc., Inc. (SMACNA).

B. All exposed exhaust ductwork serving the Kitchen range hood shall be constructed of 18-gauge No. 3 polished stainless steel. All concealed exhaust ductwork shall be unpolished 18-gauge stainless steel. All transverse joints and longitudinal seams of ductwork shall be welded liquid tight. Ductwork shall be constructed with all elbows having a minimum centerline turning radius of 1.5 times the duct width. Ductwork shall pitch back toward the hoods at minimum 0.25 inches per foot of horizontal run or as required by code. Where horizontal ducts exceed 75 feet in length, ductwork shall pitch back toward the hoods at minimum one inch per foot of horizontal run or as required by code. Install duct clean-outs in accordance with all applicable codes as required.

C. All exhaust air, return air, outside air, transfer air and mixing plenum ductwork shall be 2” pressure class.

D. All supply air ductwork systems that do not utilize variable air volume boxes shall be 2” pressure class.

E. All supply air ductwork upstream of variable air volume boxes shall be 6” pressure class.

F. All supply air ductwork downstream of variable air volume boxes shall be 2” pressure class.

G. All exposed ductwork and ductwork located in areas of cloud-type ceilings (except kitchen exhaust and other stainless steel ductwork) shall be paint grip galvanized for field painting.

H. All duct elbows shall have a minimum centerline turning radius of 1.5 times the duct width. Short radius elbows are not allowed unless the Engineer is consulted with on a case-by-case basis where space issues may arise.

2.2 LOW AND MEDIUM PRESSURE ROUND AND OVAL DUCTWORK

A. Round helically wound lock seam galvanized steel conduit.

B. All 45 deg. elbows shall have a minimum of 3 sections and all 90 deg. elbows shall have a minimum of 5 sections with a minimum centerline turning radius of 1.5 times the duct width or diameter. Smooth long sweep die formed fittings are preferred. Light gauge, adjustable elbows are not allowed. As an option, spiral duct elbows as manufactured by Tradesmen Manufacturing, or equal, will be accepted.

C. Branch ductwork take-offs shall be accomplished with a 90 deg. shoe tap saddle with an increased area connection.

D. All elbows shall be distortion free.

E. All fittings and joints to be joined using sealers in accordance with SMACNA and all state and local code requirements.

F. All exposed round or oval ductwork shall be paint grip galvanized for field painting.

2.3 FLEXIBLE DUCTWORK

A. Furnish and install flexible ducts where indicated on the drawings.

B. Flexmaster USA, Novaflex, or Buckley flexible ductwork.

C. Factory applied glass fiber insulation with vaporproof jacket, minimum total insulating value R=6.

D. The ductwork shall be UL 181 listed, Class 1 Air Duct and comply with NFPA 90A and 90B.

E. Supply, Return, and Exhaust Ducts:

1. Flexmaster Type 1M, Novaflex Type 8, or Buckley Type 3.

2. Polyethylene fabric core supported by a galvanized steel helix formed and mechanically locked to the liner.

3. Working pressure not less than 10” w.g. positive and 5” w.g. negative through 16” diameter.

4. Minimum Acoustic Performance (based on six (6) foot length):

	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
1) 8-inch dia.	16	17	18	16	11
2) 12-inch dia.	17	14	18	14	11

F. Transfer Ducts:

1. Flexmaster Type 6M, Novaflex Type 6, or Buckley Type 4.

2. Acoustical spun bond nylon fabric core supported by a galvanized steel helix formed and mechanically locked to the liner.

3. Working pressure not less than 6” w.g. positive.

4. Minimum Acoustic Performance (based on six (6) foot length):

	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
1) 8-inch dia.	13	15	16	18	16
2) 12-inch dia.	12	15	15	18	13

2.4 ACOUSTICAL LINING

A. Certainteed, Knauf, Manville or Owens-Corning Aeroflex.

B. Supply Ductwork:

1. Two inch (2") thick fibrous glass duct liner with bacteria and fungi resistant face coating, noise reduction coefficient of 0.9.

2. Minimum R=8.0.

C. Return/Exhaust/Relief/Transfer Ductwork:

1. One inch (1") thick fibrous glass duct liner with bacteria and fungi resistant face coating, noise reduction coefficient of 0.7.

D. Liner shall have a composite flame and smoke hazard rating as tested by NFPA-255 and UL-723 not exceeding 25 flame spread or 50 smoke developed.

E. Liner shall be rotary-bonded with bio-based binder, bonded mat-faced airstream surface treated with EPA-registered biocide, factory-applied edge coating, and meeting the requirements of NFPA 90A, NFPA 90B and ASTM C1071.

F. Liner shall be formaldehyde-free, shall not contain PBDEs, asbestos, mercury, mercury compounds, or lead, and shall contain a minimum of 50% recycled glass content.

G. Maximum rated air velocity of 6,000 feet per minute, less than 3% water vapor sorption, UL 2824 validated for mold and mildew growth and fungi resistance, 1.5 pounds per cubic foot density, and maximum 250 deg. F service temperature.

H. Note: Plan listed duct sizes are the clear inside dimensions. The sheet metal duct shall be increased in each dimension to accommodate the lining.

2.5 DRYER VENT DUCTWORK

A. Round helically-wound, lock seam, galvanized steel conduit.

B. All fittings shall be minimum 22 gauge galvanized steel.

C. Ninety (90) deg. elbows shall have a minimum of 5 sections or smooth welded construction.

D. Final flex connection to dryer shall meet UL listing and have a maximum length of 2'-0".

2.6 FUME HOOD EXHAUST DUCTWORK

A. Ductwork shall be G-90 coated galvanized steel wall thickness, reinforcements, seams, joints, and cross bracing in accordance with latest SMACNA standards. Seal all ductwork air-tight in accordance with SMACNA seal class A requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify dimensions at the site, making field measurements and drawings necessary for fabrication and erection. Check plans showing work of other trades and consult with Engineer in the event of any interference.

B. Make allowances for beams, pipes or other obstructions in building construction and for work of other contractors. Transform, divide or offset ducts as required, in accordance with SMACNA, except do not reduce duct to less than six inches in any dimension and do not exceed a 6:1 aspect ratio.

C. Cut or drill test holes in ducts where indicated or as required. Cap with neoprene plugs.

D. Provide frames constructed of angles or channels for coils, filters, dampers or other devices installed in duct systems, and make all connections to such equipment, including equipment furnished by others. Secure frames with gaskets and screws or nut, bolts and washers.

E. Seal all ductwork (new and re-used existing), all transverse joints, longitudinal seams, girth joints, branch intersections, fitting subsections, lower connections, grilles, registers and outlets connections, access door frame connections, etc., in accordance with SMACNA Seal Class A requirements and current IECC requirements utilizing Hardcast Inc. Sure-Grip 404 or Iron Grip 601, or equivalent, UL classified vinyl acrylic duct sealant. Clean all surfaces of dirt, oil and grease before application. Coverage to be approximately 125 square feet per gallon with 20 mil thick wet film. At Contractor’s option, duct sealing may be performed utilizing Aeroseal duct sealing system in lieu of vinyl acrylic duct sealant. The use of duct sealing tape is not acceptable.

F. Seal water-tight with G.E. Silicone Construction Sealant all joints within 6” of bottom of all outside air intake ducts and pitch outside air intakes to outside of building.

G. Seal water-tight with G.E. Silicone Construction Sealant all joints within 6” of bottom of all exhaust ductwork from outside termination back to automatic exhaust dampers and/or backdraft dampers.

H. Furnish and install a drip pan in exhaust and relief ductwork under each roof exhauster and weatherproof hood per plan detail. Seal water-tight with G.E. Silicone Construction Sealant all joints in drip pan and all joints within 6” of bottom of drip pan. For acoustically lined ductwork, terminate the duct liner within the horizontal ductwork at the point of connection to the vertical duct riser with sheet metal nosing strips. Vertical duct riser shall be externally insulated with rigid board insulation per Section 23 07 00.

I. Caulk around all ductwork passing through all walls, ceilings, and floors. For fire rated walls use United States Gypsum Thermafiber 4" thick and G.E. Pensil silicone foam sealant per plan detail. For non-rated walls fiberglass insulation may be used in lieu of the Thermafiber. For plenum walls that separate plenums from non-plenum ceiling spaces, the penetration shall be treated as a one hour fire rated wall.

J. Install all control dampers furnished by the BAS Contractor. This Contractor shall score the end of the damper rod. Scoring to be parallel with the damper blade.

K. Transverse joints of all pressure classes of ductwork may be made with Ductmate Industries, Inc. or Nexus flanged type joints, or shop fabricated TDC/TDF joints. Joints to be complete with 20-gauge angles with integral mastic sealer, gasket tape, corner pieces, snap-on cleats, etc. Joint shall have zero percent leakage at all pressures up to 10" W.G.

L. Do not install ductwork through dedicated electrical rooms or spaces unless the ductwork is serving this room or space.

M. The installation of electrical conduit of any type, low or line voltage, or piping of any kind through ductwork of any type is strictly prohibited.

N. Do not hang or support any ductwork from other ductwork or piping runs. All ductwork systems shall be independently supported from the building structure. The work of other trades shall not be supported by the HVAC ductwork or piping support systems.

O. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

P. During construction provide temporary closures of taped polyethylene or ductcap covers on open ductwork to prevent construction dust from entering ductwork system.

Q. Use double nuts and lock washers on threaded rod supports.

R. The use of wire cable as a duct support is prohibited on all exposed ductwork. Dual-cable supports with corner or side hanging brackets or trapeze hangers is allowed on concealed rectangular, oval, and round ductwork. The use of a single hanging cable will only be allowed on round ductwork.

S. All open-end ductwork and ductwork exposed within a space shall have all sharp edges rolled or flanged to eliminate any dangerous or hazardous condition.

T. All vertical ductwork shall be rigidly supported from adjacent building structure or wall to eliminate swaying or other movement.

U. All exposed ductwork shall have excess sealers and adhesive at joints removed and thoroughly cleaned for a neat appearance.

3.2 DUCT TRIM STRIPS

A. The Mechanical Contractor shall furnish and install finish trim strips of 20 gauge galvanized formed sheet steel or angle iron for all exposed ductwork wall penetrations.

3.3 FLEXIBLE DUCT

A. Flexible ducts may be used for final connection to grilles, registers and diffusers as indicated. Where flexible duct is used, it shall be the minimum length required to make the final connections, but no greater than eight (8) feet in length. Flexible ducts shall be as straight as possible with no more than one 90 deg. elbow.

B. When used in areas containing cloud-type lay-in ceilings, final connection to diffusers shall not exceed two (2) feet in length to limit flexible duct visibility.

C. Flexible ducts may be used for final connection of supply ductwork and variable volume box inlet ductwork. Where flexible duct is used, it shall be the minimum length required to make the final connections, but no greater than four (4) feet in length. Flexible ducts shall be as straight as possible with a maximum offset of 15 deg.

D. Individual sections of flexible ductwork shall be of one-piece construction. Splicing of short sections will not be accepted.

E. Penetration of any partition, wall, or floor with flexible duct will not be accepted.

F. Flexible duct may be directly connected to diffuser neck and secured with a metal draw-band.

G. Fittings, couplings, etc., shall be joined by applying a coat of 3M EC-800 or Benjamin Foster 30-02 cement to the joining surfaces. Insert the fitting to the bead and secure it with a metal draw-band. Finally, wrap exposed seam with a 3” wide band of pressure sensitive duct tape.

H. Ducts shall be hung from the building construction with galvanized steel strap hangers.

3.4 ACOUSTICAL LINING

A. All lining shall be adhered to the inside of the ductwork on all surfaces with 100% coverage of adhesive at liner contact surface area. In addition, mechanical fasteners with welded pins or fire resistive adhesive attachment clips shall be installed on 12” maximum centers and no further than 4” from the corners. Welded pins shall be installed with a Graham or equivalent capacitor type pin welder.

B. Where dampers, turning vanes or other devices are placed inside of lined ductwork, the installation must not damage the liner or cause erosion of the liner.

C. All exposed leading edges and butt joints shall be buttered with a fire-resistant adhesive coating and sheet metal nosing strips to prevent erosion of the liner material by the air stream.

D. All upstream transverse edges subjected to velocities over 4000 feet per minute shall be fitted with welded metal nosing strips.

E. Interior widths of ducts not exceeding 8” do not require mechanical fasteners in addition to adhesive.

3.5 DRYER VENT DUCTWORK

A. Connection of flexible duct to dryer and ductwork shall be made with Strap-tite duct clamps.

B. Seal all joints with adhesive-backed aluminum foil tape.

C. Install cleanout access at each vertical riser and any additional cleanouts as may be required by local, state or national codes and regulations.

D. Install permanent signage or label indicating the dryer manufacturer's maximum equivalent length requirements as required by mechanical code.

E. Furnish and install a weatherproof wall or roof vent cap with integral backdraft damper at each vent termination. Roof termination shall penetrate the roof within a prefabricated insulated roof curb as hereinbefore specified.

F. Furnish and install protective shield plates wherever nails or screws from finish work or the work of other trades are likely to penetrate the dryer exhaust vent ductwork in accordance with the requirements of IMC 504.

END SECTION 23 31 00

SECTION 23 33 07 - DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the contract, including General and Supplementary Conditions and Division 01 specification sections apply to work of this Section.

1.2 RELATED WORK

A. 23 31 00 Ductwork

1.3 QUALITY ASSURANCE

A. Substitution of Materials: Refer to General Conditions of the Contract.

1.4 SHOP DRAWINGS

A. Include dimensions, capacities, materials of construction, weights, wiring diagrams and appropriate identification for all equipment in this Section.

1.5 REFERENCE STANDARDS

A. NFPA 90A - Standard for Installation of Air Conditioning and Ventilating Systems.

B. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

C. UL 214

D. UL 555 - Standard for Fire Dampers and Ceiling Dampers.

E. UL 555S - Leakage Rated Dampers for Use in Smoke Control Systems.

PART 2 - PRODUCTS

2.1 GENERAL

A. All ductwork accessories installed within ductwork serving pool areas or moisture-related areas shall be suitable for the environment served with a zinc chromate rust resistant finish or be constructed of anodized aluminum.

2.2 MANUAL VOLUME DAMPERS

A. Air Balance, Rossi, Ruskin, Vent Products or equal.

B. Furnish manual volume dampers where indicated and where required to adjust air quantities. Maximum blade length to be 48” and maximum blade width to be 6” with double bend each edge. Each blade up to 18” long shall have 3/8” square pivot rod. Blades 19” to 48” in length shall have ½” square pivot rods for full length of blade. Provide, for each damper blade, Rossi positive locking systems, Ventlock #641, or Young Regulator Co. #403B locking damper regulator with Ventlock #607 or Young Regulator Co. #656 end bearings. When more than one damper blade is required, dampers and quadrants shall be arranged for opposed blade operation. On ducts where are internally lined, provide spacers on the damper shaft to keep the damper blades clear of the lining. Provide waterproof plywood block or Ventfabrics #637 Ventlock elevated locking damper regulator on insulated ductwork.

2.3 AIR TURNING VANES

A. Barber Colman Co. Airturns, Aero Dyne Corp. H.E.P., or equal

B. Turning vanes are required on all square or rectangular elbows greater than 45 degrees. Turning vanes are not required at radius elbows having a centerline turning radius of at least 1.5 times the duct width. Elbows with a square throat and radius heel are not acceptable.

C. Note: Shop made turning vanes will be accepted in lieu of manufactured turning vanes provided the vanes and vane runners are constructed in accordance with SMACNA standards.

2.4 FIRE DAMPERS

A. Air Balance, Cesco, Louvers & Dampers, NCA Mfg., Pottorff, Prefco, Greenheck, Ruskin, or equal.

B. In ductwork larger than 1-1/2 sq. ft., furnish and install dampers with Type B frame with damper curtain out of the air stream. In ductwork of 1-1/2 sq. ft. and smaller, furnish and install dampers with Type C frame with damper curtain completely out of the air stream for 100% free area. In all round ductwork, furnish and install dampers with Type CR frame with damper curtain completely out of the air stream for 100% free area. Complete with 4-1/2” galvanized steel channel frame and interlocking type galvanized steel blades with 22 gauge steel enclosures.

C. All dampers to meet or exceed UL minimum requirements and have fusible link with a temperature rating of 160° F.

2.5 DUCT ACCESS DOORS

A. Ductmate, Kees, Ruskin, or approved equal.

B. Furnish ultra-low leakage round metal type where indicated or as specified herein, gasketed completely, removable type with cam locks. Doors to be double walled and insulated where ductwork is lined or insulated.

2.6 DRYWALL ACCESS PANELS

A. Provide access panels of required sizes and types as required for access to all mechanical items requiring service or adjustment installed above drywall ceilings or behind drywall walls.

B. Panels shall be as manufactured by KARP and Associates, Milcor, or Titus with key locking device.

C. Panels shall be installed by the Mechanical Contractor in openings provided by the General Contractor as located and supervised by this Division.

2.7 DUCT FLEXIBLE CONNECTIONS

A. Connections to indoor air handling equipment shall be made with Ventfabrics, Inc. “Ventglas” double neoprene coated 30 oz. closely woven glass fabric. Connections to outdoor air handling equipment shall be made with Ventfabrics, Inc. “Ventlon” double hypalon coated sun and ozone resistant closely woven 26 oz. glass fabric.

B. Air handling equipment containing direct-drive plenum fans that are internally isolated and not directly connected to the unit casing, shall not require a flexible connection to the ductwork.

2.8 BRANCH DUCT TAKE-OFFS

A. Attachment of all sheet metal or flexible branch ductwork to sheet metal ducts shall be made by means of increased area (45 degree high efficiency or conical) take-off fittings.

B. Take-offs serving a single diffuser shall be complete with manual volume damper with locking quadrant and indicating pointers.

C. Straight saddle-tap type takeoffs on round or oval ductwork are not acceptable.

2.9 WIRE MESH SCREEN

A. Furnish wire mesh screen with aluminum .063” thick wires with ½ inch x ½ inch spacing.

2.10 RANGE HOOD

A. Broan, Nutone, or equal.

B. Furnish unit with dual centrifugal blower, Microtek filter system, pre-wired manual starter, variable speed control, two position light switch, aluminum grease filters and duct connector with back draft damper.

C. Baked enamel finish of standard color as selected by Architect.

2.11 WEATHERPROOF HOODS

A. Cesco, Cook, Greenheck, Louvers & Dampers, Ruskin, Vent Products, or equal.

B. Furnish complete with 16 gauge aluminum housing and curb mounting pedestal, ½" mesh bird screen and prefabricated insulated roof curb.

C. All weatherproof hoods shall have a hood free area that is a minimum of two (2) times the neck area.

D. All weatherproof hoods shall be provided with an extended throat length so that the hood opening is a minimum of 3'-0" above the finished roof.

E. Gravity backdraft damper (if control damper by BAS is not shown).

F. See architectural drawings for roof type and pitch.

2.12 WEATHERPROOF LOUVERS

A. American Warming, Air Balance Inc., Cesco, Dowco, Industrial Louvers, Inc., Louvers & Dampers, Inc., NCA Mfg., Pottorff, Reliable, Ruskin, Greenheck, Vent Products, or pre-approved equal.

B. Furnish louvers with .081" extruded aluminum alloy blades, frame and supports, horizontal "J" style drainable blades with maximum of 4'-0" unsupported length in a fixed 6" core, 6" minimum blade depth, 5-3/4" blade spacing and 37.5 deg. blade angle with hidden mullions.

C. Minimum 1,000 fpm beginning point of water penetration.

D. Furnish louvers with channel type frame for installation in new construction and flange type frame for installation in existing construction with 3/4" mesh .051" aluminum bird screen in extruded U frame mounted behind blades. All screws, bolts, hardware, etc., shall be stainless steel.

E. Units to have a baked enamel finish of custom color as selected by the Architect.

F. See architectural drawings for color and/or finish schedules and information.

PART 3 - EXECUTION

3.1 MANUAL VOLUME DAMPERS

A. Install manual volume dampers in each branch duct and for each grille, register, or diffuser as far away from the outlet as possible while still maintaining accessibility to the damper. Install so there is no flutter or vibration of the damper blade(s).

3.2 AIR TURNING VANES

A. Install all turning vanes tight to the heel of the elbow and “H.E.P.” blades spaced 2-1/2” on center.

B. Maximum unsupported length of turning vane shall not exceed 48”.

C. Where Aero-Dyne Corp. “H.E.P.” vanes are used in ducts 12” and smaller in width, provide a 1-1/2” radius in the throat of the elbow.

D. Turning vanes are not required at radius elbows having a centerline turning radius of at least 1.5 times the duct width. Elbows with a square throat and radius heel are not acceptable.

3.3 FIRE DAMPERS

A. Install dampers in strict accordance with manufacturer’s installation instructions. Install damper sleeves with retaining angles on both sides of rated partition. Connections of ductwork to fire damper assemblies to be as specified on the installation instructions. Where it is necessary to set dampers out from the rated wall, install a sleeve extension encased in two hour rated fire proofing insulation. Install an access door at each fire damper, located to permit resetting the damper and replacing the fusible link. Each access door shall be labeled with minimum .5” high letters reading “Fire Damper”.

B. See Architectural Code Plan to determine required damper ratings.

3.4 DUCT ACCESS DOORS

A. Install access doors where specified, indicated on the drawings, and in locations where maintenance, service, cleaning or inspection is required. Examples include, but are not limited to motorized dampers, fire and smoke dampers, duct smoke detectors, and square elbows with turning vanes.

B. Heating and cooling coils, filters, valves and control devices needing periodic maintenance.

C. Size and numbers of duct access doors to be sufficient to perform the intended service. Minimum access door size shall be 8 inch size for hand access, 18 inch size for shoulder access, or other size as indicated. Install access doors on both inlet and outlet sides of reheat coils as well as other duct mounted coils.

D. Each access door shall be labeled with minimum .5” high letters indicating the device served (i.e. “heating coil”, “automatic damper”, “fire damper”, etc.).

3.5 DRYWALL ACCESS PANELS

A. Install access panels where specified, indicated on the drawings, and in locations where maintenance, service, cleaning or inspection is required. Examples include, but are not limited to valves, volume dampers, motorized dampers, fire and smoke dampers, VAV boxes, booster coils, fan coils, square elbows with turning vanes, etc.

B. Size and numbers of duct access doors to be sufficient to perform the intended service. Minimum access door size shall be 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, or other size as indicated.

3.6 DUCT FLEXIBLE CONNECTIONS

A. Install at all duct connections to rotating or vibrating equipment, including air handling units, blower coil units, fan coil units, rooftop units, inline fans, or other motorized equipment in accordance with SMACNA.

B. For applications in corrosive environments or fume exhaust systems, use a double layer of the Teflon coated fabric when making the connector.

C. Flexible connections are not to be used on grease exhaust systems or dishwash exhaust systems.

3.7 BRANCH DUCT TAKE-OFFS

A. Install at all branch duct connections and in accordance with manufacturer's requirements. Takeoffs shall be as shown on the plans, details, and as required within these specifications.

3.8 RANGE HOOD

A. Install range hood(s) where indicated on the drawings and in accordance with manufacturers recommendations.

3.9 WEATHERPROOF HOODS

A. Install weatherproof hoods where indicated on the drawings and in accordance with manufacturers recommendations.

B. All weatherproof hoods (intake, relief, and exhaust) shall be mounted so that the opening is a minimum of 3'-0" above the finished roof.

C. This Contractor shall furnish the General Contractor with complete roof curb dimensions.

3.10 WEATHERPROOF LOUVERS

A. Connect outside air intake duct to the louver, sealing all connections air and water tight.

B. Install insulated metal panel on unused portion of louver. Panels must be sealed weathertight to louver assembly with flashing as required for proper drainage to outside of building.

END SECTION 23 33 07

SECTION 23 34 00 - FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the contract, including General and Supplementary Conditions and Division 01 specification sections apply to work of this Section.

1.2 RELATED WORK

A. 23 05 13 Motors and Starters

B. 23 05 14 Variable Frequency Drives

C. 23 05 15 Vibration Isolators

1.3 QUALITY ASSURANCE

A. Substitution of Materials: Refer to General Conditions of the Contract.

1.4 SHOP DRAWINGS

A. Include dimensions, capacities, materials of construction, weights, wiring diagrams and appropriate identification for all equipment in this Section.

1.5 DESIGN CRITERIA

A. Test and certify all fans in accordance with the applicable AMCA test code.

B. The motor furnished with the fan shall not operate into the motor service factor.

C. Where inlet and outlet ductwork or any fan is changed from that shown on the drawings, provide any motor, drive and/or wiring changes required due to increased static pressure or baffling necessary to prevent uneven air flow or improved mixing.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish fans of size, class, type, arrangement and capacity as scheduled on the drawings.

B. Furnish complete with motors, wheels, drive assemblies, bearings, vibration isolation devices and accessories required for specified performance.

C. Use OSHA approved belt guards that totally enclose the entire drive. Construct guards of expanded metal to allow for ventilation and provide tachometer openings at shaft locations.

D. Statically and dynamically balance all fans so they operate without objectionable noise or vibration.

E. Use AMCA Type A spark resistant construction for all fans handling flammable or grease laden air.

F. Where required, provide totally enclosed Class 1, Division 1 or Class 1, Division 2 explosion proof motors and spark resistant construction built in accordance with AMCA Type A for fans as indicated. See architectural and electrical drawings for exact requirements and area classifications.

G. Provide all fans controlled by variable frequency drives with shaft grounding rings.

H. All direct-drive fans with ECPM motors shall be selected to be capable of 125% of the scheduled design airflow and shall be capable of receiving a 0-10 vdc signal from the BAS for fan speed modulation via the integral motor variable frequency drive/motor controller.

2.2 ROOF EXHAUSTERS

A. Manufacturers: Acme, CaptiveAire, Carnes, Cook, FloAire, Greenheck, Jenco Fan, RuppAir, Thermotek, Twin City or PennBarry.

B. Furnish fans with centrifugal fan wheel, NEMA approved motor or variable speed ECPM motor as indicated, resiliently mounted with integrally wired weatherproof disconnect switch, integral vibration isolators, an aluminum weatherproof fan and motor housing with base to fit over curb and acoustically treated curb. See architectural drawings or visit the site for roof type and pitch.

C. Furnish a 24” high roof curb with sound attenuation insert for all fans with a sone rating of 15 or higher, except for grease exhaust systems and dishwash exhaust systems.

D. Direct drive as indicated.

E. Furnish integrally wired speed controller for each single-phase direct drive unit.

F. For all single-phase direct drive ECPM motors, furnish with factory pre-wired potentiometer for balancing.

G. For all three-phase units with direct drive ECPM motors, furnish with factory pre-wired PM compatible variable frequency drive/motor controller.

H. For all direct-drive fans with fan speed controlled by the BAS in a variable speed application, fans shall be selected with full design airflow achieved at 60 Hz or higher for VFD controlled fans (maximum 70 Hz) or 10 vdc for single-phase ECPM motors to maximize unit turndown capabilities.

2.3 CEILING EXHAUST FANS

A. Manufacturers: Acme, Broan, Cook, Carnes, FloAire, Greenheck, Jenco Fan, RuppAir, Thermotek, Twin City or PennBarry.

B. Furnish acoustically insulated fan and motor housing, direct connected centrifugal fan with variable speed ECPM motor or permanently lubricated ball bearing motor as indicated, integral inlet grille, self-acting backdraft damper, and speed control. Termination shall be roof jack, roof cap with roof curb, wall cap, or eave cap as indicated.

2.4 DESTRATIFICATION FAN

A. Manufacturers: Big Ass Pivot, Envirofan Gold Line, Berko, Broan or Q-Mark.

B. Furnish 3 blade fan of diameter scheduled, dynamically balanced with permanently lubricated ball bearing motor, cast iron motor housing, U.L. listed, with all necessary hooks, safety cables and supports for a complete installation. Provide separate solid state speed controller for each fan.

2.5 DESTRATIFICATION FANS - HVLS

A. Manufacturers: Altra-Air Sailfin, Big Ass Fan, Entrematic, Greenheck, MacroAir, Refresh Fans, Rite-Hite, Rupp, Swifter Fans, or pre-approved equal.

B. Furnish minimum six-blade fan of diameter scheduled, dynamically balanced with an ECPM variable speed motor with integral VFD, U.L. listed, with all necessary hooks, safety cables and supports for a complete installation.

C. Remote control panel wall mounted with on/off control, fan speed control, LCD display and keypad, and BACnet for BAS connection and control.

D. Powder coated airfoil blades of custom colors as selected by the Architect. See architectural drawings for color and/or finish schedules and information.

E. Custom hub cover to match blade color.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all fans where indicated on the drawings and in accordance with manufacturers recommendations.

B. Field verify all existing dimensions prior to ordering any fan array system.

C. The Mechanical Contractor shall turn over all solid-state speed controllers serving direct-drive fans and destratification fans to the Electrical Contractor for installation and coordinate required locations.

D. All suspended fans shall be supported from steel supports with suspensions, frames, brackets, braces, etc. Supports shall be constructed to properly support and distribute the load and shall incorporate anti-vibration devices, anti-sway bracing, and anchoring plates as required. Supports may be constructed of I-beams, channels, angle iron or threaded steel rods. All permanent supports shall be welded. All threaded rods and bolts shall have nuts welded to rod, threads peened or double nuts.

E. Roof curb mounted equipment shall be mounted on factory constructed curbs furnished with the fans. Roof curbs shall extend not less than 12" above adjoining roof surface and shall be sized to accommodate the roof openings and curb flange of the equipment being mounted. The curbs shall be constructed suitable to accommodate anchoring of the equipment being mounted. See Section 23 05 12 for roof curb requirements.

F. Ceiling exhaust fans shall have concealed supports and shall be set with the fan housing flush with the finish ceiling and inlet grille furnished with the fan shall cover opening between fan housing and ceiling.

G. Roof caps shall be mounted on factory constructed curbs furnished with the fans. Roof curbs shall extend not less than 12" above adjoining roof surface and shall be sized to accommodate the roof openings and curb flange of the roof cap being mounted. See Section 23 05 12 for roof curb requirements.

H. Destratification fans shall be suspended from the building construction and the blade assemblies shall be balanced after installation to assume stable operation. Safety cables shall be installed to prevent the fan from falling to the floor if the main support fails.

I. Destratification fans with ball bearing motors and solid-state speed controllers controlled by the BAS for temperature control shall be set to operate at 75% capacity (adjustable) to reduce fan noise within the space. Locate speed controllers in electrical panel that serves the related space. Coordinate with the Electrical Contractor.

END SECTION 23 34 00

SECTION 23 37 00 - DIFFUSERS, GRILLES AND REGISTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the contract, including General and Supplementary Conditions and Division 01 specification sections apply to work of this Section.

1.2 QUALITY ASSURANCE

A. Substitution of Materials: Refer to General Conditions of the Contract.

1.3 SHOP DRAWINGS

A. Include dimensions, capacities, materials of constructions, weights, wiring diagrams and appropriate identification for all equipment in this Section.

PART 2 - PRODUCTS

2.1 DIFFUSERS, GRILLES AND REGISTERS

A. Manufacturers: Agitair, Anemostat, Carnes, Greenheck, Krueger, Metalaire, Nailor, Price, Reliable, Shoemaker, Titus, or Tuttle and Bailey.

B. All diffusers, grilles and registers shall be provided with frame style appropriate for the ceiling installation type. Grilles and diffusers located in lay-in type ceilings shall be furnished with a frame or panel for lay-in installation. See architectural room finish schedule for ceiling types, grid sizes, etc. The Mechanical Contractor is responsible for coordinating the exact lay-in panel size with the appropriate grid type and size.

C. All grilles and registers located in ceilings shall be furnished with baked enamel finish of color selected by the Architect. See architectural drawings for color and/or finish schedules and information.

D. All grilles and diffusers located in walls, soffits, or exposed shall be furnished with a prime coat suitable for field painting. Coordinate with the Architect.

E. All sidewall grilles located on a wall constructed of gypsum wall material shall be provided with a mud-in frame to be flush with the gypsum wall surface.

F. All diffusers, grilles and registers with round duct collars shall be provided with suitable adapter plenums. All visible interior surfaces of the adapter plenums shall be painted with a flat black finish. All supply adapter plenums shall be insulated to prevent condensation. All adapter plenums shall be minimum 6” deep.

G. All diffusers, grilles and registers installed in fire rated ceilings shall be provided with radiation or fire dampers as applicable. See architectural code compliance plans.

2.2 SIDEWALL SUPPLY GRILLES

A. Furnish grilles with adjustable double deflection steel grille core, flanged frame with sponge rubber gasket, horizontal face blades with 3/4" maximum blade spacing and vertical rear blades.

2.3 SIDEWALL EXHAUST, RETURN, AND TRANSFER GRILLES

A. Furnish grilles with steel grille core, flanged frame with sponge rubber gasket, fixed horizontal face blades with a ¾" maximum blade spacing set in an angular position.

2.4 CEILING EXHAUST, RETURN, AND TRANSFER GRILLES (EGG CRATE)

A. Furnish grilles constructed of aluminum with 1/2 x 1/2 x 1/2 fixed aluminum grid. Grilles for T-bar lay-in installation shall have a lay-in type border. Raw egg crate material without a lay-in border will not be accepted. Surface mounted type to have flange type frame with countersunk holes for surface mounting.

2.5 PLAQUE TYPE CEILING DIFFUSERS

A. Furnish plaque type ceiling diffusers with a removable 22-gauge steel face panel with the exposed surface of the face panel smooth, flat and free of visible fasteners. Flanged or lay-in frame as required. Round duct connection type shall be provided with minimum 1.25" high beaded connection collar.

2.6 MAXIMUM SECURITY TRANSFER GRILLES

A. Furnish with 3/16" steel perforated face plate with 5/16" holes on 7/16" staggered centers, 3/16" welded steel sleeve with a 1 x 1 x 3/16" angle frame and furnished with stainless steel finish.

2.7 MAXIMUM SECURITY EXHAUST, RETURN, AND SUPPLY REGISTERS

A. Furnish with 3/16" steel perforated face plate with 5/16" holes on 7/16" staggered centers, 3/16" welded steel sleeve with a 1 x 1 x 3/16" angle frame, furnished with stainless steel finish and a key operated opposed blade volume damper adjustable through the grille face.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install diffusers, grilles and registers where indicated on the drawings.

B. For diffusers, grilles and registers located in a lay-in type ceiling, the Mechanical Contractor shall provide all additional ceiling grid tees as required to support or frame the diffuser, grille or register.

C. All sidewall grilles and registers shall be installed on a low-loss fitting with a 45-degree tapered takeoff. Straight-in duct taps will not be accepted.

D. Coordinate exact and final location of all diffusers, grilles and registers with final lighting and ceiling layout.

END SECTION 23 37 00

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SECTION 23 52 12 - SEALED COMBUSTION CONDENSING BOILERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the contract including General and Supplementary Conditions and Division 01 specification sections apply to work of this Section.

1.2 RELATED WORK

A. 23 05 13 Motors and Starters

B. 25 09 00 Building Automation System

C. 25 09 93 Control Sequences

1.3 QUALITY ASSURANCE

A. Substitution of materials: Refer to General Conditions of the Contract.

1.4 SHOP DRAWINGS

A. Include dimensions, capacities, materials of construction, weights, wiring diagrams and appropriate identification for all equipment in this Section.

1.5 DESIGN CRITERIA

A. Constructed in accordance with ASME and Wisconsin Boiler codes.

B. Electrical components and work must be in accordance with National Electrical Codes.

PART 2 - PRODUCTS

2.1 SEALED COMBUSTION CONDENSING BOILERS

A. Manufacturers: Aerco Benchmark, Bryan FF Series, Fulton Endura, Patterson Kelley Sonic or Solis, Lochinvar Crest, RBI Flexcore, Riello Array, Thermal Solutions Arctic, Camus Avenger, Laars MagnaTherm, Raypak X-Vers, Viessmann Vitocrossal, or Cleaver Brooks Clear-Fire C.

B. Boiler shall be complete in accordance with all CSD-1 certified requirements.

C. Furnish each boiler built for minimum 125 PSIG design pressure and equipped with a 60 PSIG ASME relief valve and trim. The Boiler shall be capable of handling 50 deg. F return water and be of a full condensing design. Furnish the following boiler trim: modulating combustion air

blower assembly, fan motor overload protection, ignition transformer, pilot igniter, high-limit aqua-stat, operating limit aqua-stat, low water cutoff, and full modulation burner operation.

D. Furnish GCA, FM or UL listed factory mounted and wired main gas train including following main components: main entrance shut-off gas cock, low gas pressure switch, main gas regulator, redundant automatic gas valves and test ports. Furnish one motorized and one diaphragm gas valve on boilers with 1,000 MBH input and less. Furnish two motorized gas valves for boiler inputs greater than 1,000 MBH. Equip each boiler with an intermittent gas pilot with pilot gas train. Furnish a positive shutoff step-down gas pressure regulator suitable for pressure indicated with internal relief if required.

E. Control:

1. Furnish a BACnet (ASHRAE 135) digital controller to provide burner start up sequencing, flame supervision, safety shutdown with display of error, fault history log and modulating burner control.

2. Controller shall be capable of resetting the set point from an external analog signal as well as an external boiler system enable/disable. The controller shall provide the ability to continuously monitor fault history, time of fault, inlet water temperature, outlet water temperature, desired supply water temperature, burner modulation rate, stack temperature, outside air temperature, outside air/supply water reset control, boiler lead/lag, and alarms, and shall relay this information to the BAS and operator workstation.

3. Upon loss of communication with the BAS, the internal boiler controller shall default to a supply water temperature setpoint of 160 degrees F until communication with the BAS is restored.

4. Two-way hot water stop valve and normally open two-position actuator for each boiler.

5. The Mechanical Contractor shall verify coordination with the BAS Contractor prior to ordering the equipment. See 25 09 93 Control Sequences for complete control sequence requirements.

6. The manufacturer shall make a factory technician available to the BAS Contractor for coordination and mapping assistance as required to provide a fully integrated interface with the BAS.

F. The factory pre-wired control panel shall include an on-off switch, electronic combination temperature control/flame safeguard system, circuit breaker, LED Display module used to adjust set points and control parameters. LED display to indicate burner sequence, all service codes, fan speed, boiler set point, sensor temperature values such as inlet, outlet, flue gas and outdoor air.

G. The boiler heat exchanger shall be of stainless steel arranged in a counter flow design. The heat exchanger shall be arranged in a reverse return configuration to assure balanced water flow through each section. The boiler heat exchanger headers shall be completely removable for waterside inspection.

H. The natural gas power burner shall be fully modulating minimum 5:1 turndown. The blower shall be variable speed. The burner shall be constructed from stainless steel material. Furnish positive shutoff step-down gas pressure regulator suitable for pressure indicated with internal relief if required.

I. For each boiler, furnish drains, combustion air and vent piping including vertical combustion air and vertical vent pipe to the outdoors in accordance with the boiler manufacturers' recommendations.

J. Combustion air ductwork shall be single wall galvanized steel and insulated.

K. Flue vent piping shall be category four, UL 1738 listed, double wall stainless steel with Viton gaskets or RTV Red gaskets, or polypropylene venting with gasketed joints as approved by the boiler manufacturer. PVC or CPVC venting products will not be accepted.

L. Condensate piping with inline acid neutralizer per manufacturer recommendations. See Section 23 20 01 for drain piping requirements.

M. The boiler manufacturer shall, in addition to initial start-up, provide parts, service and adjustment of the boiler for a period of one year after final acceptance of boilers. A qualified representative of the manufacturer shall perform all service work. Copies of a certified service agreement shall accompany the boiler shop drawings submitted for approval.

N. In addition to the above warranty, the burner will be covered by a 5-year replacement warranty. This burner warranty will cover all freight, service and equipment costs should a burner fail within 5-years from date of initial start-up.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Furnish and install a water pressure gauge at the inlet connection to each boiler.

B. Boilers shall be installed where indicated on the drawings on 3-1/2" high concrete pads or wall mounted and in accordance with manufacturers recommendations. Boilers shall be set a minimum of 18" apart to allow adequate service area around each boiler.

C. Entire installation shall be complete and in accordance with all CSD-1 requirements as well as all other Federal, State and Local code requirements. The mechanical contractor shall obtain the boiler permit and coordinate the boiler inspection. All deficiencies identified by the local inspector shall be corrected by the mechanical contractor prior to turning the building over to the Owner.

D. Boiler drain piping, intake air piping and vent piping shall be installed in accordance with manufacturer's directions. Combustion air and exhaust venting shall penetrate the roof within a roof curb. The use of roof penetration boots or simple flashing is not acceptable.

E. Relief valves shall be piped to the nearest floor drain. Relief valves on systems containing glycol shall be piped to a 55-gallon drum located near the relief valve.

F. The venting manufacturer shall check the plans and verify that adequate clearance to combustible surfaces is allowed, that the combustion air and vent stack is sized adequately, and that the installation is installed in accordance with written factory recommendations. Verify that the vent stack height is coordinated with the height of the combustion air intake to prevent flue gas recirculation. The combustion air intake shall be a minimum of 3'-0" above the roof surface.

G. All gas vent outlets shall be piped to atmosphere.

H. Manufacturers shall check the plans and verify that his boiler burner unit is piped and controlled in accordance with factory recommendations. Modifications recommended by the manufacturer shall be provided to the Mechanical Contractor.

I. All field wiring shall be done by the BAS Contractor except power wiring to the unit.

J. The equipment manufacturer shall provide technical assistance to the BAS Contractor as required to facilitate mapping of all available control points from the BACnet controller to the OWS. At a minimum the following points shall be mapped and available at the OWS.

1. All binary I/O points such as boiler status, flow status, etc.

2. All analog I/O points such as inlet temperature, outlet temperature, burner firing rate, etc.

3. All adjustable setpoints such as supply water temperature, return water temperature, max. water temperature rate of rise, etc. Setpoints shall be adjustable via the OWS.

4. All alarm conditions shall be available at the BAS user interface.

END SECTION 23 52 12

SECTION 23 62 13 - AIR COOLED COMPRESSOR CONDENSING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the contract including General and Supplementary Conditions and Division 01 specification sections apply to work of this Section.

1.2 RELATED WORK

A. 23 05 13 Motors and Starters

B. 23 05 15 Vibration Isolators

C. 23 20 04 Piping Specialties

D. 23 20 07 Refrigerant Specialties

1.3 QUALITY ASSURANCE

A. Substitution of Materials: Refer to General Conditions of the Contract.

1.4 SHOP DRAWINGS

A. Include dimensions, capacities, materials of constructions, weights, wiring diagrams, job tailored piping diagrams and appropriate identification for all equipment in this Section.

1.5 DESIGN CRITERIA

A. Electrical components and work must be in accordance with National Electrical Codes and bear the UL label.

PART 2 - PRODUCTS

2.1 AIR COOLED COMPRESSOR CONDENSING UNITS

A. Base Bid Manufacturers: Aaon, Carrier, Trane or York.

B. Alternate Bid Manufacturer: Daikin Applied

C. Furnish units complete with suction and discharge shut-off valves, liquid shut-off valve, suction line strainer, aluminum microchannel coil air-cooled condenser with hail guards, condenser fan and motor, receiver pressure relief valve, and high and low pressure cutouts. Units shall have scroll type compressors. Units shall have at least one digital or variable speed scroll compressor or hot gas bypass capacity control and compressor sound blankets. Also furnish crankcase

heater, oil failure switch, force feed lubrication system, full charge of compressor oil, nitrogen holding charge, and integral steel base. Furnish magnetic contactors, non-restarting pump-down relay, one for each DE coil with 24 volt holding coil, weatherproof fused disconnect switch, vibration isolation as indicated, a time delay relay and an anti-short cycle timer. Provide a 5-year parts-only compressor warranty.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units where indicated on the drawings in accordance with manufacturers recommendations.

B. Provide full factory start-up services and warranty effective from the date of start-up.

C. Refrigerant piping, quantities, and specialties shall be complete and in accordance with all manufacturer recommendations and requirements. Refrigerant piping shown on the plans is for routing purposes only.

D. Units mounted on the roof shall be set on prefab equipment support rails as manufactured by Pate, Thy or Vent Products. Rails shall be sized for equipment being mounted, complete with minimum 18-gauge galvanized steel construction with integral base plate, continuous welded corner seams, factory installed wood nailer, counter flashing with lag screws and built in cant for roof as required. See Architectural plans or visit the site for roof deck type, pitch and insulation thickness. Equipment support rails shall be furnished by the Mechanical Contractor and installed by the Mechanical Contractor. Coordinate mounting height of disconnect with the Electrical Contractor to comply with NEC requirements. Disconnect shall be field installed on a support stand separate from the unit.

E. The equipment manufacturer shall provide technical assistance to the BAS Contractor as required to facilitate mapping of all available control points from the unit controller to the OWS.

END SECTION 23 62 13

SECTION 23 72 05 - ENERGY RECOVERY UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the contract, including General and Supplementary Conditions and Division 01 specification sections apply to work of this Section.

1.2 RELATED WORK

A. 23 05 13 Motors and Starters

B. 23 05 15 Vibration Isolators

C. 23 05 16 V-Belt Drives

1.3 QUALITY ASSURANCE

A. Substitution of Materials: Refer to General Conditions of the Contract.

1.4 SHOP DRAWINGS

A. Include dimensions, capacities, materials of construction, weights, wiring diagrams and appropriate identification for all equipment in this Section.

1.5 DESIGN CRITERIA

A. Electrical components and work must be in accordance with National Electrical Codes and bear the UL label.

B. Provide all fans controlled by variable frequency drives with shaft grounding rings.

PART 2 - PRODUCTS

2.1 ENERGY RECOVERY UNITS

A. Manufacturers: American Aldes, Greenheck, Oxygen8, Renewaire, or pre-approved equal.

B. Furnish sectionalized double-wall casing of one-inch (1”) thick insulated steel (insulated walls, roof and floor) fully weatherproof for rooftop mounting for units indicated, all necessary access panels to service fan bearings and dampers, and a factory fabricated insulated roof mounting curb for units indicated.

C. Intake and exhaust hoods for units indicated.

D. Centrifugal supply and exhaust fan wheels with ball bearing supports, grease bearing extensions, NEMA approved resiliently mounted ODP motors with adjustable motor mounts and v-belt drive, or direct-drive with EC motors, and vibration isolation.

E. Access doors shall be double wall insulated doors with piano hinges and a minimum of two compression latches.

F. Aluminum or resin composite crossflow plate heat exchanger with aluminum framing.

G. An exhaust air filter section with 2" thick pleated MERV 8 throwaway filters.

H. An outside air filter section with 2" thick pleated MERV 13 throwaway filters.

I. Low leakage type, aluminum opposed blade, outside air and exhaust air dampers with extended shafts for damper operators.

J. Factory pre-wired variable frequency drives for supply fan and exhaust fan motors with ODP motors. Units with direct-drive EC motors shall receive 0-10 vdc signal from the BAS.

K. The unit manufacturer shall perform initial start-up of the unit including verification of all Control Sequences.

L. The unit manufacturer shall, in addition to initial start-up, provide parts, service and adjustment of the unit for a period of one year after final acceptance of the unit. A qualified representative of the manufacturer shall perform all service work.

M. Copies of the certified start-up and service agreement shall accompany the unit shop drawings submitted for approval.

N. Unit shall be completely factory prewired with a single point power connection and shall include variable frequency drives and fused disconnects.

O. Furnish factory fabricated roof mounting curb as hereinbefore specified for units mounted on roof.

P. Entire unit shall be prewired to a terminal strip ready for field installation of automatic controls. See Section 25 09 93. The Mechanical Contractor shall verify coordination with the BAS Contractor prior to ordering equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Units shall be mounted where indicated on the drawings and fully installed in accordance with the unit manufacturer's requirements. All field wiring shall be done by the BAS Contractor except power wiring to the unit.

B. Floor mounted units shall be set on concrete pads unless indicated otherwise. Concrete pads shall be a minimum of 3-1/2" thick and shall be sized for a minimum overlap of 3" on the exterior dimension of the unit mounted thereon.

C. For all roof-mounted units, unit roof curb shall be installed per detail and/or installation shall include minimum six inches (6") of Rockwool insulation, two layers of 5/8" mold resistant gypsum board, three inches (3") of expanding spray foam insulation within the entire curb base, and three inches (3") of expanding spray foam insulation below the entire unit on the underside of the roof decking. All edges, seams, and joints shall be thoroughly filled and sealed with the expanding spray foam insulation to eliminate noise penetration through any gaps around pipe risers, duct drops, or electrical conduits. Spray foam below the roof decking within the building shall be coated with a minimum 15-minute thermal barrier product, Fire-Lok DC-315 fireproof paint, or equal.

D. Contractor shall check the plans and verify the proposed unit can be installed in the space allotted and still have adequate room for servicing. All piping and/or duct modifications required for installation of the unit shall be the responsibility of the Mechanical Contractor.

E. For roof-mounted units, coordinate mounting height of disconnect with the Electrical Contractor to comply with NEC requirements. Disconnect shall be field installed on a support stand separate from the unit.

F. Provide full factory start-up services and warranty effective from the date of start-up.

END SECTION 23 72 05

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SECTION 23 73 13 - AIR HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections apply to work of this Section.

1.2 RELATED WORK

A. 23 05 13 Motors and Starters

B. 23 05 14 Variable Frequency Drives

C. 23 05 15 Vibration Isolators

1.3 QUALITY ASSURANCE

A. Substitution of Materials: Refer to General Conditions of the Contract.

1.4 SHOP DRAWINGS

A. Include leakage rates (percent of total airflow), dimensions, capacities, materials of construction, railings, weights, wiring diagrams and appropriate identification for all equipment in this Section.

1.5 DESIGN CRITERIA

A. Test, certify, and label all units in accordance with applicable AMCA test codes and ARI Standard 430.

B. Unit leakage rate shall not exceed 2% of total system airflow when subjected to +/- 5” static pressure.

C. Each fan and motor combination shall be capable of delivering 110% of air quantity scheduled at scheduled static pressure. The motor furnished with the fan shall not operate into the motor service factor when operating under these conditions.

D. Where inlet and outlet ductwork or any fan is changed from that shown on the drawings, provide any motor, drive and/or wiring changes required due to increased static pressure or baffling necessary to prevent uneven air flow or improved mixing.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish type, arrangement and capacity as scheduled.

B. Statically and dynamically balance all fans to operate without excessive noise or vibration.

C. Fan motors shall be 1750 rpm. The use of 3600 rpm motors shall only be allowed when absolutely necessary due to fan selection limitations.

D. All access sections to be complete with hinged access panels with door handles and located on the primary service side of the unit as shown on the plans. Section shall be minimum 18" in length.

E. All blank sections shown on details upstream of fan modules, air blenders, etc. to be complete with hinged access panels with door handles and located on the primary service side of the unit as shown on the plans. Section shall be minimum 18" in length.

F. Unit coil connections shall be located on the back side of the unit, opposite the primary service side of the unit and/or as shown on the plans.

G. All dampers shall be Class1A leakage rated, insulated airfoil blade type.

H. Provide all fans controlled by variable frequency drives with shaft grounding rings.

2.2 AIR HANDLING UNITS

A. Base Bid Manufacturers: Aaon, Carrier 39MN, Trane Performance Series or York Solutions.

B. Alternate Bid Manufacturer: Daikin Applied Vision Series

C. Furnish sectionalized two-inch (2") thick foam-injected double-wall casing of insulated steel with bonderized paint or galvanized steel finish, base rails and all necessary access panels to service fan bearings, coils and dampers. Complete with insulated waterproofed drain pan. Furnish blank sections as indicated or required to provide service access.

D. Variable aspect ratio as required to meet dimensional requirements as scheduled.

E. Airfoil centrifugal wheel plenum fan with direct connected NEMA approved open ball bearing motor. Provide fans and motors of the number indicated. Multiple fan motors shall be factory pre-wired to a terminal strip for field installed variable frequency drive(s).

F. Type "B" vibration isolators for fan and motor base. See Section 23 05 15.

G. Fan diameter and speed as required such that the setpoint of the variable frequency drive does not exceed 70 Hz, or as indicated, to meet the scheduled design parameters.

H. Plenum fan section with no supply connection openings from the factory. Supply connection sizes scheduled shall be field cut by the Mechanical Contractor.

I. Furnish base rail of sufficient height such that the bottom of the drain pan discharge pipe is a minimum of 8” above the unit mounting surface.

J. Provide coils with a maximum fin spacing of 14 fins per inch.

K. Drainable hot water coil constructed of copper tubes and aluminum fins.

L. Direct expansion cooling coil of refrigerant circuits indicated with refrigerant distributor and suction header, constructed of copper tubes and aluminum fins (for units indicated).

M. Furnish a mixing box with one duct inlet opening as indicated with angle arrangement 2” thick low velocity throwaway MERV 13 filters.

N. Furnish filter draft gauge with 0” to 2” H_2O range scale.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units where indicated on plans.

B. For indoor units, the Mechanical Contractor shall field cut the supply duct openings under the direction of the unit manufacturer. Provide sheet metal nosing strips as required and completely seal the unit casing at the opening to prevent any air from entering the insulation space between the unit walls.

C. Floor mounted units shall be set on concrete pads unless indicated otherwise. Concrete pads shall be a minimum of 3-1/2” thick and shall be sized for a minimum overlap of 3” on the exterior dimension of the unit mounted thereon.

D. Provide loop seal per detail at each cooling coil drain pan connection.

E. Contractor shall check the plans and verify the proposed unit can be installed in the space allotted and still have adequate room for servicing. All piping and/or duct modifications required for installation of the unit shall be the responsibility of the Mechanical Contractor.

F. Hot water coil shall be fitted with manual air vent assemblies at the top of each header and for each return bend header. Vent pipes shall extend through the exterior of the unit casing and each shall be complete with manual air vents.

G. Hot water coil shall be fitted with drain piping at each header and for each return bend header. All drain pipes shall extend through the exterior of the unit casing and shall be fitted with full size drain valves with male hose bibb fitting.

END SECTION 23 73 13

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SECTION 23 74 11 - EQUIPMENT SCREENS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pre-formed thermoplastic panel for screening roof top mechanical equipment.

2. Aluminum assembly framing for direct attachment of screening panels to mechanical equipment; no base or curb required.

3. Aluminum extrusions to permit easy access to mechanical equipment for servicing.

1.2 RELATED SECTIONS

A. 23 72 05 Energy Recovery Units

1.3 REFERENCES

A. American Society for Testing and Materials: Standard Specifications for

1. ASTM B 221-96 - Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire Profiles, and Tubes.

B. The Aluminum Association, Inc.

1. AA ADM-1516166 (1994) - Aluminum Design Manual

C. American Society of Civil Engineers.

1. SCE 7-95 - Minimum Design Loads for Buildings and Other Structures.

1.4 SYSTEM DESCRIPTION

A. Design Criteria:

1. Manufacturer is responsible for the structural design of all materials, assembly and attachments to resist snow, wind, suction and uplift loading at any point without damage or permanent set.

2. Framing shall be designed in accordance with the Aluminum Design Manual to resist the following loading:

a. ASCE 7-95 - Minimum Design Loads for Buildings and Other Structures; American Society of Civil Engineers.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum five (5) years documented experience producing systems specified in this section.

1.6 PROJECT CONDITIONS

A. Field Measurements: Take measurements of actual roof top mechanical equipment for fit without gaps. Indicate measurements on shop drawings fully documenting any field condition that may interfere with the screen system installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Envisor Screening System by CityScapes Inc., or approved equal.

2.2 MATERIALS

A. Thermoformed plastic panels fabricated from rigid medium impact thermo-formed ABS sheets.

B. Minimum thickness 3/16”.

C. Framing: ASTM B221 Aluminum plate, shapes and bar.

D. Threaded Fasteners: All screws, bolts, nuts and washers shall be stainless steel.

2.3 FABRICATION

A. Provide factory formed panel systems with continuous interlocking panel connections and all necessary components. Form all components true to shape, accurate in size, square and free from distortion or defects. Cut panels to precise lengths as required for the specific application.

B. Panel height shall be selected from manufacturer standard panel sizes but shall be sufficient to fully conceal equipment from view.

C. Panel style shall be vertical.

D. Panel design shall be louver.

E. Panel color shall be selected by the Architect from manufacturer standard options. See architectural drawings for color and/or finish schedules and information.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units in accordance with the manufacturer's instructions. Keep perimeter lines straight, plumb, and level. Provide brackets, anchors, and accessories necessary for a complete installation.

B. Fasten structural supports to HVAC units without damaging operation of the unit.

1. Provide corner and mid-span assemblies as required so that the panels are supported uniformly.

2. Fasten bottom rail using bolts to permit ease of access to HVAC units.

3. If required by the equipment manufacturer, provide additional support attaching screens to equipment support curbs and/or rails. Support systems on or through the roof are not acceptable.

4. The Mechanical Contractor shall verify all supports required with the actual equipment manufacturer supplied.

C. Insert thermoplastic panels into structural supports. Butt thermoplastic panels to adjacent panels for uniform fit.

D. Metal Separation: Where aluminum materials would contact dissimilar materials, insert rubber grommets at attachment points, thus eliminating where dissimilar metals would otherwise be in contact.

END SECTION 23 74 11

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SECTION 23 82 01 - HEATING AND COOLING TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections apply to work of this Section.

1.2 RELATED WORK

A. 23 05 13 Motors and Starters.

1.3 QUALITY ASSURANCE

A. Substitution of Materials: Refer to General Conditions of the Contract.

1.4 SHOP DRAWINGS

A. Include dimensions, capacities, materials of construction, weights, wiring diagrams and appropriate identification for all equipment in this Section.

1.5 DESIGN CRITERIA

A. Forced Circulation Coils: Ratings certified in accordance with ARI 410.

B. Electrical components and work must be in accordance with National Electrical Codes.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish types, arrangement and capacities as scheduled.

B. See architectural drawings for color and/or finish schedules and information.

2.2 CONVECTORS

A. Manufacturers: Airtherm, Embassy, Modine, Rittling, Rosemex, Sigma, Sterling, Vulcan or approved equal.

B. Construct heating elements of copper tubes with aluminum fins expanded into cast iron or brass headers. Support heating elements on adjustable brackets to allow for expansion and pitch.

C. Furnish the following types as indicated on plan schedule:

1. Type W: Wall hung, sloping top outlet grille, 16 gauge front and enclosure.

2. Type RGB: Fully recessed, front inlet and outlet grilles, four-sided recess flange, 16 gauge front and 20 gauge enclosure.

D. Cabinets to have a baked enamel finish of manufacturers standard color as selected by Architect.

2.3 UNIT HEATERS

A. Manufacturers: Airtherm, Embassy, Modine, Rittling, Rosemex, Sigma, Sterling, Trane, VTS Volcano, or Vulcan.

B. Furnish units with direct driven propeller fan, hot water or steam coil as indicated, constructed of copper tubes and aluminum fins and totally enclosed resiliently mounted motor of speed indicated with unit-mounted disconnect.

C. Horizontal units to have adjustable horizontal discharge louvers and safety fan guard.

D. All units to have manufacturers standard baked enamel finish.

2.4 CABINET HEATERS

A. Manufacturers: Airtherm, Embassy, Modine, Rittling, Rosemex, Sigma, Sterling, Trane or Vulcan.

B. Construct heating elements of copper tubes with aluminum fins expanded into cast iron or brass headers. Coils to be hot water or steam type as indicated.

C. Hot water coils shall be minimum 2-rows. Single row coils will not be accepted.

D. Furnish cabinets of 16 gauge steel with forward curved centrifugal fan, ECPM motor, direct drive, built-in motor overload protection and disconnect switch, three speed and on-off switch. Switches to be prewired and integrally mounted in cabinet with access door on floor mounted units. Switches to be shipped loose for ceiling mounted units for field installation by the Mechanical Contractor.

E. Furnish manual air vent where indicated.

F. Furnish the following types as indicated on plan schedule:

1. Type IW: Wall mounted with top front inlet grille and bottom front outlet grille.

G. Cabinets to have a baked enamel finish of manufacturers standard color as selected by Architect.

2.5 VARIABLE AIR VOLUME BOXES

A. Manufacturers: Anemostat, Carnes, Carrier, Enviro-Tec, Greenheck, Johnson Control, Krueger, Metalaire, Nailor, Price, Titus, Trane or Tuttle & Bailey.

B. Furnish units with galvanized steel casing, minimum 1/2" thick mat faced fiberglass thermal acoustic insulation on inside surfaces, inlet and outlet duct collars, factory mounted access door in bottom of unit for access to coil inlet, and low leakage variable volume damper with extended damper shaft.

C. Units to have multi-point velocity pressure measurement grid, flow taps and calibration chart.

D. Furnish minimum two (2) row hot water reheat coil with copper tubes and aluminum fins. Single-row heating coils are not allowed.

E. Note: VAV box unit size selections shall be made by the manufacturer based on the maximum airflows scheduled at the maximum air pressure drop scheduled. VAV box heating coil selections shall be made by fixing the design water flow rates (gpm) to the scheduled values. Leaving air temperatures shall meet or exceed the scheduled values.

2.6 BOOSTER COILS

A. Manufacturer: Carrier, Coil Master, Commercial Coil, Johnson Control, Daikin Applied, Precision Coil, RAE or Trane.

B. Furnish coils with copper tubes and aluminum fins, galvanized steel casing with drilled flanges for installation in ductwork and turbulators as required.

C. Types as follows:

1. Single tube serpentine construction with same end connections for coils with a face area of 3 sq. ft. or less and standard single row serpentine construction with inlet and outlet heaters for coils with a face area over 3 sq. ft.

2.7 ROOM AIR CONDITIONING UNITS

A. Manufacturers: Carrier, Mitsubishi, Samsung, or approved equal.

B. Furnish a unit with a galvanized steel cabinet with a baked enamel finish, with a horizontal ceiling mounted or wall mounted evaporator section as indicated, front discharge grille, and cleanable filter. Ceiling mounted units shall have a connection for an outside air duct.

C. Disconnect switches for both indoor and outdoor units.

D. Motor to be multi-speed as indicated with speed switch prewired in cabinet.

E. Exterior remote mounted condensing unit with air cooled condenser and hermetic compressor and pre-insulated refrigerant lineset from evaporator to condensing unit.

F. Low outdoor ambient control with wind baffles to allow condensing unit operation down to -20 degree F outdoor temperature.

G. BACnet controller for interface with the BAS.

H. Drain water lift-up unit.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

A. Install units in accordance with manufacturers installation instructions.

B. Install branch water or steam/condensate piping to each unit with a minimum of three elbows to allow for expansion and contraction of the piping.

C. Coordinate location of units with other trades to assure correct recess size for recessed units.

D. After installation, provide protective covers to prevent accumulation of dirt on unit during balance of construction.

3.2 CONVECTORS

A. Mount units in locations indicated on the drawings and as detailed.

B. Verify that any unit installed in a fire rated wall will not destroy the integrity of the rating

3.3 UNIT HEATERS

A. Suspend units from building structure a minimum of 8’-0” above finish floor (to bottom of unit) or as indicated on schedule to maintain head room beneath units. Supporting from piping system will not be accepted.

3.4 CABINET HEATERS

A. Mount units in locations indicated on the drawings with bottom of unit at minimum 8” above finished floor unless indicated otherwise.

B. Verify that any unit installed in a fire rated wall will not destroy the integrity of the rating.

C. Install speed control and on-off switches shipped loose for all ceiling mounted units above ceiling near unit.

3.5 VAV BOXES

A. Mount units in ductwork in locations indicated on the drawings and as detailed.

3.6 BOOSTER COILS

A. Mount units in ductwork in locations indicated on the drawing and as detailed.

B. Comb bent or crushed fins and clean dust and debris from each coil before installing coil in ductwork. Pitch coil casings in accordance with manufacturers instructions.

C. Furnish and install a cleanout door in ductwork on both sides of coil of size indicated.

3.7 ROOM AIR CONDITIONING UNITS

A. Mount units in locations indicated on the drawings.

B. Remote mounted condensing unit and/or heat pump to be grade, wall or roof mounted as indicated.

C. Units on grade to be mounted on precast concrete pads 3” larger than base of the unit and 4” thick.

D. Wall mounted units to be supported with steel wall support brackets furnished, installed and painted by the Mechanical Contractor.

E. Roof mounted units to be mounted on equipment support rails as hereinbefore specified and Type “W” vibration pads. See Sections 230512 and 230515.

END SECTION 23 82 01

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SECTION 23 82 05 - ELECTRIC HEATING TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 specification sections apply to work this Section.

1.2 RELATED WORK

A. 23 05 13 Motor and Starters.

1.3 QUALITY ASSURANCE

A. Substitution of Materials: Refer to General Conditions of the Contract.

1.4 SHOP DRAWINGS

A. Include dimensions, capacities, materials of construction, weights, wiring diagrams and appropriate identification for all equipment in this Section.

1.5 DESIGN CRITERIA

A. Electrical components and work must be in accordance with National Electrical Codes.

B. Electrical equipment and heaters shall be UL listed for service specified.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish types, arrangements and capacities as scheduled.

2.2 ELECTRIC WALL HEATERS

A. Manufacturers: Berko, Brasch, Electromode, Markel or Q-Mark.

B. Furnish units with steel or anodized aluminum 16 gauge front cover with pencil-proof louvered inlet and discharge grilles, steel sheath enclosed fin tube heating element, fan and PSC fan motor. Factory assembled, wired and tested. Recessed or surface type mounting box as indicated with baked enamel finish.

C. Complete with built-in fan delay switch, automatic reset thermal overheat protector, built-in disconnect switch and integral thermostat with a tamper resistant adjustment.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

A. Install units in accordance with manufacturers installation instructions.

B. Install room thermostats and control wiring as required for units indicated.

C. Coordinate location of units with other trades to assure correct recess size for recessed units.

D. After installation, provide protective covers to prevent accumulation of dirt on unit during balance of construction.

3.2 ELECTRIC WALL HEATERS

A. Mount units in locations where indicated on the drawings.

END SECTION 23 82 05

SECTION 23 82 07 - GAS HEATING TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 specification sections apply to work of this Section.

1.2 RELATED WORK

A. 23 05 13 Motor and Starters

1.3 QUALITY ASSURANCE

A. Substitution of Materials: Refer to General Conditions of the Contract.

1.4 SHOP DRAWINGS

A. Include dimensions, capacities, materials of construction, weights, wiring diagrams and appropriate identification for all equipment in this Section.

1.5 DESIGN CRITERIA

A. Electrical components and work must be in accordance with National Electrical Codes.

B. All units shall be AGA approved.

C. All units to conform to ANSI standards.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish types, arrangements and capacities as scheduled.

2.2 SEPARATED COMBUSTION GAS FIRED DUCT FURNACES

A. Manufacturers: Airtherm, Modine, Reznor or Sterling.

B. Furnish unit with steel cabinet, stainless steel burner for natural or propane gas operation as indicated, built-in draft diverter, inlet and outlet duct connections and pipe cap hangers. Units to have a baked enamel finish.

C. Adjustable gas pressure regulator, automatic safety pilot, main and pilot manual shut-off valves and heat exchanger high temperature limit control.

D. Aluminized steel heat exchanger.

E. Low voltage (24 volts) automatic gas valve.

F. Electric pilot ignition.

G. Two stage gas valve.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

A. Install units in accordance with manufacturers installation instructions.

3.2 SEPARATED COMBUSTION GAS FIRED DUCT FURNACES

A. Install units in ductwork where indicated on the drawings.

B. Support unit from building structure.

C. Install exhaust venting and combustion air ducting from unit to outside as indicated and as per manufacturer recommendations.

END SECTION 23 82 07

SECTION 24 05 00 - TESTING AND BALANCING OF HVAC SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the contract, including General and Supplementary Conditions and Division 01 specification sections apply to work of this Section.

1.2 RELATED WORK

A. 25 09 00 Building Automation System

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. The Mechanical Contractor shall obtain the services of an independent NEBB, TABB or AABC certified subcontractor who specializes in and whose business is limited to testing, adjusting and balancing of air and water distribution systems. All tests shall be performed with recently calibrated instruments suitable for the test being performed. This subcontractor (TAB) shall be responsible for complete testing, adjusting and balancing of the hydronic systems and all new and remodeled air moving systems. **Testing and balancing shall not be performed by the installing contractor or any subsidiary of the installing contractor**.

B. Inspecting, Checking and Testing System:

1. TAB Contractor shall submit to the owner, in triplicate, at the completion of his work a certified statement signed by a principal of the firm stating that the system has been fully adjusted and balanced in accordance with requirements outlined and that all system components have been checked and tested, adjusted, and is operating properly as noted by plans and specifications. This statement shall be submitted before the system is presented to the Owner for final inspection.

C. Approved test and balance contractors:

1. Balance Technologies
2. Balco Balancing
3. Badger Balancing
4. ESA
5. Midwest Fluid Balancing
6. Precision Balancing Group

7. Professional Systems Analysis

3.2 HYDRONIC BALANCE

A. The balancing work shall include the compiling of data, submitting reports and performing the following tests:

1. Pumps

a. Design Data:

1) GPM.

2) RPM, BHP.

b. Installed Equipment:

1) Manufacturer, size.

2) Impeller diameter as shipped.

3) Impeller diameter after trimming for installed conditions.

4) Type drive.

5) Motor HP, volts, cycles and phase.

6) Full load amperes.

c. Field Test:

1) Discharge pressures: Full flow and no flow.

2) Suction pressures: Full flow and no flow.

3) Operating head and GPM.

4) Full flow amperes, no flow amperes.

5) Calculated BHP.

6) Differential pressure setpoint (for each sensor location).

d. Primary water balancing shall be accomplished by trimming of the pump impeller. Fine balancing only will be permitted by means of triple duty and/or balancing valves. Triple-duty and/or balancing valves shall not exceed twenty percent (20%) closed to achieve design parameters.

e. System design water gpm and pump head shall be achieved with the pump VFD setting at 60 Hz to maximize system turndown capability. The VFD shall not be used as a means to balance a variable flow pump.

2. Heating and Cooling Elements:

a. Design Data:

1) MBH specified, GPM specified.

2) Required water temperature drop.

3) Element type specified.

b. Field Test:

1) Identify each element as to location.

2) GPM actual. (where calibrated balancing valves are provided)

3) Actual entering and leaving air temperatures.

4) Adjust element until required temperature drop is obtained.

B. In addition to the above work, the TAB Contractor shall check operation of all automatic temperature control equipment, verify all setpoints and operations, and enlist the aid of the BAS Contractor to make necessary adjustments where required.

1. Where pressure independent control valves have been installed, the TAB Contractor shall coordinate with the BAS Contractor to obtain control valve performance charts to determine the flow rate through the control valve.

2. The TAB Contractor shall set up all system bypass valves with system flow meters as indicated on the plans.

C. Lead/lag system pumps shall be balanced with one pump at full capacity and again with both pumps at full capacity to determine proper VFD settings at both system conditions.

D. The TAB Contractor shall determine the minimum differential pressure setpoint required to obtain design flow rate at terminal units for each differential pressure sensor location and communicate each setpoint to the BAS Contractor.

3.3 AIR BALANCE WORK

A. Air balance work shall pertain to all types of air handling equipment including but not limited to air handling units, rooftop units, makeup air units, energy recovery units, fan coil units, blower coil units, furnaces, dust collectors, exhaust fans, supply fans, relief fans, etc.

B. The setting and adjusting of all dampers, deflecting vanes, discharge vanes and accessories to achieve indicated air distribution patterns in all parts of the air systems. Air quantities shall be as designated, with allowable error of plus or minus 5%.

C. The setting and adjusting of all belted fan speeds as may be required to attain proper total CFM deliveries, including the furnishing and installation of additional belts and drives as dictated by field conditions. For belt-driven VAV units, the sheaves shall be adjusted or replaced as

required to achieve full design airflow with the motor VFD at 60 Hz to optimize unit turndown capabilities. For direct-drive VAV units, the motor VFD shall be set as required to achieve the unit manufacturer's design fan speed as indicated in the certified shop drawings performance data. This setting must be verified as in many cases it will be in excess of 60 Hz.

D. The inspection of the function and operation of all automatic controls to ensure proper operation and control cycles.

E. Submitting a report on each phase of the work.

F. Air balancing shall be accomplished with duct volume dampers and not dampers at the terminal outlets. Fine balancing will be permitted by means of terminal outlet dampers.

G. Record all test data in triplicate and submit to Architect.

H. Air System Balance:

1. With the air handling systems set to operate at full scheduled supply fan speed, the TAB Contractor shall perform the following tests and compile the following information:

a. Air Handling Equipment

1) Design Conditions:

a) CFM supply air.

b) Static pressure.

c) Motor HP

d) Outside air CFM (minimum).

e) Outside air CFM (maximum).

f) Fan RPM.

g) Fan motor brake horsepower.

2) Installed Equipment:

a) Manufacturer.

b) Size.

c) Arrangement, discharge class.

d) Motor HP, voltage, phase, cycles, full load amperes.

3) Field Test:

a) Fan speed.

b) No load operating amperes.

c) Fan motor operating amperes.

d) Calculated BHP.

e) Static pressure.

4) Test for Total Air:

a) Size of discharge and outside air ducts.

b) Number of and location of velocity and pressure readings.

c) Duct average velocity.

d) Total CFM.

e) Outside air CFM (minimum).

f) Outside air CFM (maximum).

g) Return air CFM (minimum).

h) Return air CFM (maximum).

b. Individual Terminal Outlets:

1) Identify each supply outlet and exhaust as to location area and fan system.

2) Manufacturer and type.

3) Size.

4) Free area, core area or neck area.

5) Terminal factor.

6) Required FPM and test velocity.

7) Required CFM and test results.

2. In addition to the above work, check operation of all automatic temperature control equipment, verify all thermostat, aquastat, airstat, etc., setpoints and operations, and enlist the aid of the BAS Contractor to make necessary adjustments where required.

END SECTION 24 05 00

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SECTION 25 09 00 - BUILDING AUTOMATION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 RELATED WORK

A. 23 52 12 Sealed Combustion Condensing Boilers

B. 23 62 13 Air Cooled Compressor Condensing Units

C. 23 72 05 Energy Recovery Units

D. 23 73 13 Air Handling Units

E. 25 09 93 Control Sequences

F. Division 26 Electrical

1.3 DEFINITIONS

A. BACnet: Building Automation and Control Network Standard (ASHRAE 135)

B. BAS: Building Automation System

C. DDC: Direct digital control.

D. I/O: Input/output.

E. IP: Internet Protocol

F. MS/TP: Master slave/token passing.

G. PC: Personal computer.

1.4 SYSTEM DESCRIPTION

A. The Building Automation System (BAS) manufacturer shall furnish and install a fully integrated building automation system, incorporating direct digital control (DDC) for all equipment and systems as herein specified.

B. System shall be an open protocol and unlocked Tridium/Niagara HTML5-based (non-Java) system and shall utilize BACnet communication according to ASHRAE standard

ANSI/ASHRAE 135 for interoperability with smart equipment and for the main BACnet/IP communication trunk to the BAS Server.

C. System shall be provided to accept future integration of building lighting systems, security/access systems, camera systems, and fire alarm systems. It is understood that these systems must have full BACnet integration capability in order to be integrated into the BAS.

D. The BAS shall reside on its own network and be completely independent of the Owner's network.

E. All necessary software (open license), licensing, programming tools, hardware, firmware, operating equipment, devices and system components required for the system shall be provided by the BAS Contractor to the Owner whether or not specifically itemized, in order to provide a complete system within the intent of this specification.

F. Provide Owner with field controller level software for full system access and editability along with a minimum of four (4) hours of training for the software. The head end and programming capabilities of downstream controllers shall not be locked in any way.

G. The building management system shall support any JDBC (Java DataBase Connectivity) compliant engine including Apache Derby, Microsoft SQL, MySQL, PostgreSQL and Oracle 12c, MS Access® MySQL 5.6, MS SQL Server 2012 Express R2 & 2008 Express R2, MS SQL Server 2012 R2 & 2008 R2, PostgreSQL 8.4 and 9.4 Oracle® 11gR2. Ownership of the database software shall be solely assigned to the Owner. The installing contractor shall not retain ownership of the database software, any required licenses or associated data.

H. Provide the tools to create, edit, simulate, debug, and download custom programs. System shall be fully operable while custom programs are edited, compiled, and downloaded. Language shall be graphically based and shall use function blocks arranged in a logic diagram that clearly shows control logic flow. Operator shall be able to step through the program observing intermediate values and results. Operator shall be able to adjust input variables to simulate actual operating conditions. Operator shall be able to adjust each step's time increment to observe operation of delays, integrators, and other time-sensitive control logic. Ownership of the logic/programming software shall be solely assigned to the building owner. The installing contractor shall not retain ownership of the logic/programming software, any required licenses or associated data.

I. All project-specific software and documentation shall become Owner's property. This includes, but is not limited to: Graphics, Record drawings, Database, Application programming code, and Documentation.

1.5 SYSTEM PERFORMANCE

A. Comply with the following performance requirements:

1. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:

a. Water Temperature: Thermistor plus or minus 0.3 deg. F; RTD and Transmitter plus or minus 0.5 deg. F.

b. Water Flow: Plus or minus 2 percent of full scale at 77 deg. F and pure water. Plus or minus 6 percent whole range temperature and glycol.

c. Water Pressure: Less than plus or minus 1 percent of measuring range.

d. Space Temperature: Plus or minus 1 deg F.

e. Ducted Air Temperature: Plus or minus 0.9 deg F.

f. Outside Air Temperature: Plus or minus 0.7 deg F.

g. Dew Point Temperature: Plus or minus 3 deg F.

h. Temperature Differential: Plus or minus 0.25 deg F.

i. Relative Humidity: Plus or minus 2 percent.

j. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.

k. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.

l. Airflow (Terminal): Plus or minus 10 percent of full scale.

m. Air Pressure (Space): Plus or minus 0.01-inch wg.

n. Air Pressure (Ducts): Plus or minus 0.04-inch wg.

o. Carbon Monoxide: Plus or minus 5 percent of reading.

p. Carbon Dioxide: 3 percent of the reading, plus or minus 50 ppm.

q. Electrical: Plus or minus 5 percent of reading.

1.6 SUBMITTALS

A. Product Data:

1. Include manufacturer's technical literature for each control device and software. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

2. Where there are options on the accuracy, signals, covers, ranges, etc., indicate on the data sheet which options area being selected.

3. Schedule of dampers including size, leakage, and flow characteristics.

4. Schedule of valves including flow characteristics.

B. Shop Drawings:

1. Detail system assemblies and indicate device locations, wiring connections, associated control panel connections and sequence of operations to be executed by the DDC program.

2. Bill of materials for all devices, controller, accessories, and software indicating quantity, manufacturer, model number and description. The description shall include options that are chosen for that device, such as accuracy, signals, covers, ranges.

3. Schematic flow diagrams showing fans, pumps, equipment, coils, dampers, valves, and control devices.

4. Written description of sequence of operation.

C. Wiring Diagrams:

1. Power, signal, and control wiring, differentiating clearly between manufacturer-installed and field installed wiring.

D. DDC System Hardware:

1. Wiring diagrams for control units with termination numbers.

2. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.

E. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ANSI/ASHRAE Standard 135 “BACnet – A Data Communication Protocol for Building Automation and Control Networks” where indicated.

F. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors. Revise Shop Drawings to reflect actual installation and operating sequences.

G. Operation and Maintenance Data:

1. For HVAC instrumentation and control system to include in maintenance manuals. In addition to items specified elsewhere in Division 23 include the following:

a. Interconnection wiring diagrams with identified and numbered system components and devices.

b. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

1.7 QUALITY ASSURANCE

A. Provide principal digital temperature control equipment and materials as manufactured by a single manufacturer.

B. All work shall be installed by mechanics, electricians and technicians directly employed by the BAS manufacturer or by an authorized independent manufacturer's field office.

C. The BAS manufacturer shall be responsible for the proper installation and operation of the BAS.

D. Use only UL labeled products which comply with NEMA Standards. Electrical components and installation to meet all requirements of the electrical sections (Division 26) of project specifications.

E. Comply with ANSI/ASHRAE Standard 135 "BACnet – A Data Communication Protocol for Building Automation and Control Networks" where indicated.

F. Store equipment and materials inside and protected from weather.

G. All materials and equipment used shall be standard components, regularly manufactured for HVAC applications. All systems and components shall have been thoroughly tested and proven in actual use.

H. The installation of the control system shall be performed under the direct supervision of the controls manufacturer with the shop drawings, flow diagrams, bill of materials, component designation or identification number and sequence of operation all bearing the name of the manufacturer. The installing manufacturer shall certify in writing, that the shop drawings have been prepared by the equipment manufacturer and that the equipment manufacturer has supervised their installation. In addition, the equipment manufacturer shall certify, in writing, that the shop drawings were prepared by their company and that all temperature control equipment was installed under their direct supervision.

I. BAS Contractor shall be responsible for all BAS and Temperature Control wiring and conduit for a complete and operable system.

J. BAS Contractor shall provide login information to the Engineer at project completion for a review of the graphical interface and monitoring of the installed system operation. The login shall be for viewing purposes only.

K. BAS Contractor shall coordinate all IP address requirements with the Owner.

1.8 WIRING

A. All wiring and data cabling shall be done in accordance with all requirements of Division 26 and 27 as well as all local and national codes.

B. All electrical wiring required for electrical interlocking, fan timers, selector switches, speed switches, damper motors, control panels, etc., and all wiring required for the complete installation of the BAS shall be by the BAS Contractor. The only wiring by the Electrical Contractor shall be the primary power wiring from panelboards to starters and/or VFD's and from starters and/or VFD's to motors and power wiring to electrical resistance heating equipment (see E-Series drawings). All other control-related power wiring for the complete mechanical system shall be by the BAS Contractor.

C. Power wiring, circuit breakers, and conduit for BAS control panels shall be furnished and installed by the BAS Contractor and shall be connected to separate circuit breakers within the

nearest available panelboards and shall be dedicated to the BAS equipment. See Electrical drawings and coordinate with the Electrical Contractor.

D. Power shall be wired from emergency power equipment branch panels for control panels serving boilers, pumps, and other equipment on emergency power. See Electrical drawings and coordinate with the Electrical Contractor.

E. Data cabling and conduit for BAS devices and/or panels shall be furnished and installed by the BAS Contractor and shall be connected to building data system routers and/or switches. Coordinate requirements with the data cabling contractor and the Owner's I.T. manager.

1.9 COORDINATION

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

B. Coordinate/confirm location of destratification fan override switches with Owner before installation.

C. Coordinate equipment with the Electrical Contractor to achieve compatibility with motor starters and annunciation devices.

D. Coordinate all IP address requirements with the Owner.

1.10 WARRANTY

A. Provide all services, materials and equipment necessary for the successful operation of the entire BAS system for a period of one year after final acceptance of the system.

B. The adjustment, required testing, and repair of the system includes all computer equipment, transmission equipment and all sensors and control devices.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The BAS shall be bid as an alternate add to the base bid mechanical systems (Divisions 23 and 24). See Section 23 05 00 for requirements.

B. Tridium/Niagara N4 System provided by one of the following manufacturers:

1. ABB Controls installed by KLPD.

2. Alerton Controls installed by Masters' Building Solutions.

3. Honeywell installed by Control Works, Inc.

4. Johnson Controls installed by HVA Products, Inc.

2.2 BAS NETWORK

A. Provide a primary backbone network between the Building Level System Controllers, BAS Server and Operator Workstations based upon BACnet/IP. Ethernet Network switches shall be placed throughout the building as required.

B. Building Level System Controllers shall be used for the central heating and cooling plants and other equipment as indicated in Section 250993 and shall reside on the backbone network.

C. The Building Level System Controllers shall be able to support one of several sub-network protocols that may be needed depending on the type of equipment or application.

D. Advanced Application Controllers and Application Specific Controllers can reside on the primary backbone network or on a sub-network.

E. Provide all communication media, data cabling, connectors, repeaters, bridges, switches, and routers necessary for the internetwork.

F. Label all controllers with MAC and IP addresses, terminated and labeled into data racks.

2.3 OPERATOR INTERFACES

A. Operator Workstation hardware (OWS):

1. Personal computer operator workstations shall be utilized for command entry, information management, system monitor, alarm management and database management functions. All real-time control functions shall be resident in the Building Controllers to facilitate greater distribution, fault tolerance and reliability of the building automation control.

a. Furnish and install head end hardware in Owner’s server room or as directed by the Owner. Upgrade the existing server for full compatibility with the new system and provide additional licensing as required. Furnish and install software on a designated PC workstation as directed by the Owner.

b. Furnish and install a PC workstation in the Maintenance Office, as indicated on the drawings or as directed by the Owner.

2. Server/Operator Workstation Setup (Unlimited Users and Customizable or Predefined Privilege Sets)

a. 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. 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.

b. System shall use BACnet protocol for communication between the control modules and web server. Communication between the web server and the user's browser shall be HTTP or HTTPS protocol utilizing HTML5. Use of Adobe Flash technology is not acceptable. Web pages generated by this server shall be compatible with the latest versions of Microsoft Internet Explorer or Edge, Google Chrome, Mozilla Firefox, and Apple Safari browsers. Any of these supported browsers connected to the server shall be able to access all system information.

c. The building management system shall support unlimited concurrent users. Each user shall be capable of having full access and functionality within the system.

d. Each operator shall be required to log onto the system with a username and password to view, edit, add, or delete data. The username and password combination shall define accessible viewing, editing, adding, and deleting privileges for that operator. The system shall be capable of being configured with individual user privileges for each operator or with preset user groups that operators are placed into.

3. Phone/Tablet Versatility (No Additional Program or App Required)

a. Mobile devices shall be recognized by the web server and shall supply the appropriate system content as needed including graphics and all application software. System web pages shall be accessed via Microsoft Internet Explorer or Edge, Google Chrome, Mozilla Firefox, or Apple Safari browsers. The user environment on a mobile device shall be the same as the user environment via access of the system from a web browser on a personal computer or laptop. No program or mobile device app shall be required to interact with the system via the mobile device.

B. Operator Interface Software:

1. Operator interface software shall minimize operator training through the use of user-friendly and interactive graphical applications, on-line help, and industry standard application software. Interface software shall simultaneously communicate with and share data between connected building level networks.

2. Provide a graphical user interface that shall minimize the use of keyboard through the use of a mouse or similar pointing device, with a "point and click" approach to menu selection and a "drag and drop" approach to inter-application navigation.

3. The navigation shall be user friendly by utilizing "forward & back" capability between screens and embedded hyperlinks to open graphics, documents, drawings, etc.

4. The software shall provide a multi-tasking type environment that allows the user to run several applications simultaneously.

5. The software shall provide, as a minimum, the following functionality:

a. Real-time graphical viewing and control of the BAS environment.

b. Reporting of both real-time and historical information.

c. Scheduling and override of building operations.

d. Collection and analysis of historical data.

e. Point database editing, storage and downloading of controller databases.

f. Utility for combining points into logical Point Groups. The Point Groups shall then be manipulated in Graphics, trend graphs and reports in order to streamline the navigation and usability of the system.

g. Alarm reporting, routing, messaging, and acknowledgment.

h. Definition and construction of dynamic color graphic displays.

i. On-screen access to User Documentation, via online help or PDF-format electronic file.

j. Automatic database backup at the operator interface for database changes initiated at Building Controllers.

k. Display dynamic trend data graphical plot.

l. Must be able to run multiple plots simultaneously.

m. Program editing.

6. Security: Operator-specific password access protection shall be provided to allow the administrator/manager to limit users' workstation control, display and data base manipulation capabilities as deemed appropriate for each user, based upon an assigned password.

7. The operator interface software shall also include an application to track the actions of each individual operator, such as alarm acknowledgement, point commanding, schedule overriding, database editing, and logon/logoff. The application shall list each of the actions in a tabular format and shall have sorting capabilities based on parameters such as ascending or descending time of the action, or name of the object on which the action was performed. The application shall also allow querying based on object name, operator, action, or time range.

8. Dynamic Color Graphics application shall include the following:

a. Shall include graphic editing and modifying capabilities.

b. A library of standard control application graphics and symbols must be included.

c. Shall be able to command points directly off graphics application.

d. Graphic display shall include the ability to depict real-time point values dynamically with animation, picture/frame control, symbol association, or dynamic informational text-blocks.

e. Graphics shall be capable of displaying the status of points that have been overridden.

9. Reports shall be generated on demand or via pre-defined schedule, and directed to CRT displays, printers or file.

10. Scheduling and override

a. Provide a calendar type format for simplification of time and date scheduling and overrides of building operations. Schedule definitions reside in the PC workstation and in the Building Controller to ensure time equipment scheduling when PC is off-line, PC is not required to execute time scheduling. Provide override access through menu selection, graphical mouse action or function key. Provide the following capabilities as a minimum:

1) Daily, Weekly, and Monthly schedules

2) Ability to combine multiple points into a logical grouping (Zone) for ease of scheduling (e.g., Building 1 lights)

3) Ability to combine multiple groups of points into a common collection (Event) for scheduling (e.g., Building 1 and Parking Lot A lights)

4) Schedule predefined reports that can be sent to a printer, hard drive location, or emailed.

11. Collection and Analysis of Historical Data

a. Provide trending capabilities that allow the user to easily monitor and preserve records of system activity over an extended period of time. Any system point may be trended automatically at time-based intervals or change of value, both of which shall be user-definable. Trend data shall be collected and stored on hard disk for future diagnostics and reporting.

b. Panels shall have a trending level above which the data will be automatically uploaded to the BAS server to prevent overwriting the data in the field panel.

c. Trend data reports shall be provided to allow the user to view all trended point data. Reports may be customized to include individual points or predefined groups of selected points.

d. Provide additional functionality that allows the user to view real-time trend data on trend graphical plot displays. The dynamic graphs shall continuously update point values. At any time, the user may redefine sampling times or range scales for any point.

12. Integral System Documentation

a. All project record documents shall reside within the building management system. The documents must be embedded within the associated graphics for the equipment or system. The user shall be able to access the relevant documents via

clicking on a link on the respective graphic. For graphics with multiple links, the links shall be organized in an expandable tree format with the links grouped in a logical manner. The documents shall be accessed without the operator having to exit the building management system operator interface software. It is not acceptable to simply save files on the server/operator workstation hard drive.

b. The following documents must be embedded within the system graphics at a minimum (see below image for sample layout):

1) Equipment O&M's (PDF from equipment manufacturer)

2) Controller and control device cut sheets (PDF)

3) Control as-built documentation (PDF) including control diagrams, wiring diagrams, etc.

4) System or Equipment As-Built Sequence of Operations

13. Dynamic Color Graphic Displays

a. Capability to create color graphic floor plan displays and system schematics for each piece of mechanical equipment, including, but not limited to, air handling units, chilled water systems, hot water boiler systems, and room level terminal units.

b. The operator interface shall have the ability allow users to access the various system schematics and floor plans via a graphical penetration scheme, menu selection, point alarm association, or text-based commands. Graphics software shall permit the importing of AutoCAD or scanned pictures for use in the system.

c. Dynamic temperature values, humidity values, flow values and status indication shall be shown in their actual respective locations within the system schematics or graphic floor plan displays and shall automatically update to represent current conditions.

d. At a minimum, all items listed under "control devices for each unit" within each control sequence in Section 25 09 93 shall be shown graphically as a point for each piece of equipment. All graphics shall be coordinated with and verified by the Owner prior to or at the time the graphics are being produced.

e. All system and space setpoints shall be both viewable and editable on each of the graphical displays.

f. In addition to standard equipment graphics, each system or piece of equipment controlled shall be provided with a live graphic that shows all inputs and outputs to the system/equipment controller. The graphic shall include a realistic depiction of the controller (same model and type as installed) with labels indicating all points connected to the inputs and outputs. The live data associated with the points shall also be shown and shall be distinguished by a different color from the remaining information on the graphic.

g. All graphics pages shall be provided with notetaking functionality. There shall be a notes icon on each page that brings up a graphic that allows the user to type in customized text-based notes. The notes shall be able to record equipment status, user adjustments, etc. The user shall have the ability to mark the notes as important which shall be denoted on the main graphic page by changing the "Notes" letters red. Users shall also be able to mark notes as read which will turn the "Notes" letters back to the default color.

14. Custom 3D Graphics Representing Installed Equipment

a. All graphics shall be 3D and shall graphically represent the system/equipment controlled. Two-dimensional or single line type graphics and diagrams are not acceptable. All sensors and devices including coils, valves, dampers, etc. shall be shown on the graphics. The devices shown shall be 3D and shall be a realistic depiction of the actual item.

b. All live data shall be easily identifiable via text in a color other than the default text color used.

c. Links shall be provided on each graphic to allow the user to access graphics for associated systems and equipment. For example, an air handling unit shall include graphics to the chiller plant and boiler plant serving the air handling unit as well to the floor served by the equipment. Likewise, each terminal unit graphic shall contain links to the systems serving it as well as the associated floor plan. Interfaces to equipment such as chillers, boilers, variable frequency drives, etc. shall be available for each system. The user shall easily be able to move throughout the system without having to frequently go back to the home screen or use the navigation tree.

d. Information available via equipment interfaces shall not simply be listed in table format. Instead, this information shall be displayed in graphical format.

e. All setpoints and control points requiring adjustability shall be accessible via the system or equipment graphic.

15. Equipment Dashboards and Summary Graphics

a. Summary graphics shall be provided for all equipment and systems such as a central heating or cooling plant and main pieces of equipment such as air handling units. The dashboards and summary graphics shall organize data so that the user can easily access relevant data and see snapshots of equipment operation. Dashboards shall also show information such as system efficiency, energy usage, etc. These graphics shall be provided in addition to system graphics referenced earlier within this document. Specific information to be detailed on each dashboard and graphic shall be coordinated with the owner prior to installation.

16. System Auditing

a. All users accessing the system shall have their actions recorded. Information recorded shall include user login and logout times and dates and all user system

modifications with before and after values detailed. The system shall have the ability to report user activity based on individual and/or date and time.

C. System Configuration & Definition

1. A “Collapsible tree” dynamic system architecture diagram/display application of the site-specific BAS architecture showing status of controllers, PC workstations and networks shall be provided. This application shall include the ability to add and configure workstations, Building Controllers, as well as third-party integrated components. Symbols/Icons representing the system architecture components shall be user-configurable and customizable, and a library of customized icons representing third-party integration solutions shall be included. This application shall also include the functionality for real-time display, configuration and diagnostics connections to Building Controllers.

2. Network wide control strategies shall not be restricted to a single Building Controller but shall be able to include data from any and all other network panels to allow the development of Global control strategies.

3. Provide automatic backup and restore of all Building Controller databases on the workstation hard disk. In addition, all database changes shall be performed while the workstation is on-line without disrupting other system operations. Changes shall be automatically recorded and downloaded to the appropriate Building Controller. Changes made at the user-interface of Building Controllers shall be automatically uploaded to the workstation, ensuring system continuity.

4. System configuration, programming, editing, graphics generation shall be performed on-line.

5. User shall be able to edit point configuration online within a dedicated editor application that is part of the operator interface software. The editor shall allow the user to create, view existing, modify, copy, and delete points from the database.

6. The point editor shall have the capability to assign “informational text” to points as necessary to provide critical information about the equipment.

7. The point editor shall also allow the user to configure the alarm management strategy for each point. The editor shall provide the option for editing the point database in an online or offline mode with the Building Controllers.

8. Control program configuration shall be available to the user within a dedicated control program editor application included in the operator interface software. The editor shall allow for creation, modification and deletion of control programs. The editor shall include a programming assistance feature that interactively guides the user through parameters required to generate a control program. The editor shall also include the ability to automatically compile the program to ensure its compatibility with the Building Controllers. The editor shall provide the option for editing the control programs in an online or offline mode, and also the ability to selectively enable or disable the live program execution within the Building Controllers.

9. Users shall have the ability to view the program(s) that is/are currently running in a Building Controller. The display shall mark the program lines with the following: disabled, comment, unresolved, and trace bits.

D. Alarm Management

1. Provide alarm notifications for all HVAC equipment controlled by the BAS including all air handling equipment, heat pumps, chillers, boilers, pumps, fans, rooftop units, etc. Verify alarm notification requirements with the Owner. Typical alarm notifications shall include but not be limited to fan/pump failures, temperature setpoint failures, building pressure, hot water temperature, chilled water temperature, alarms from manufacturer-provided BACnet controllers, economizer fault detection and diagnostics (FDD) in accordance with IECC, boiler plant emergency stop notification, etc.

2. Alarm Routing shall allow the user to send alarm notification to selected printers, email addresses, text message addresses or workstation location(s) based on time of day, alarm severity, or point type.

3. Alarm messages shall be customizable for each point, or each alarm priority level, to display detailed instructions to the user regarding actions to take in the event of an alarm.

E. Remote notification of messages

1. Operator Interface software shall be configured to send out messages to phones, text messaging devices, and email accounts based on a point's alarm condition.

2. System must be configurable to send messages to an escalation list so that if the first device does not respond, the message is sent on to the next device after a configurable time has elapsed.

3. Message detail shall be configurable on a per user basis.

2.4 REMOTE WEB APPLICATION OPERATOR INTERFACE

A. The BAS shall provide a web based graphical interface that allows users to access the BAS data via the Internet, extranet, or Intranet. The interface shall use HTML based ASP pages to send and receive data from the BAS to a web browser.

B. Furnish and install a web server computer complete with the most current operating system software.

C. Access to the web interface shall be password protected. A users rights and privileges to points and graphics shall be the same as those assigned at the OWS.

D. All graphics available at the OWS shall be available to users via a web browser.

E. The web-based interface shall provide the following functionality to users, based on their access and privilege rights:

F. Logon Screen – allows the user to enter their username, password and Domain name for logging into the web server.

G. Alarm Display – a display of current BAS alarms to which the user has access shall be displayed. Users shall be able to acknowledge and erase active alarms, and link to additional alarm information including alarm messages, and informational and memo text. Any alarm acknowledgements initiated through the web interface shall be written to the BAS central workstation activity log.

H. Graphic Display – display of system graphics available in the BAS workstation shall be available for reviewing over the web browser. A graphic selector list shall allow users to select any graphics to which they have access. Graphic displays shall automatically refresh with the latest change of values. Users shall have the ability to command and override points from the graphic display as determined by their user accounts rights.

I. Point Details – users shall have access to point detail information including operational status, operational priority, physical address, and alarm limits, for point objects to which they have access rights.

J. Point Commanding – users shall be able to override and command points they have access to via the web browser interface. Any commands or overrides initiated via the web browser interface shall be written to the BAS central workstation activity log.

K. Remote Communications: Provide a communication port for connection to the BAS network for remote web based communications. Provide coordination with the Owner for addressing and router configuration on both ends of the remote network.

L. The web server licensing options shall allow concurrent access by 5 browser connections.

M. Internet connections, ISP services, as well as necessary firewalls or proxy servers shall be provided by the BAS Contractor for the duration of the warranty period as required to support the web access feature.

2.5 GRAPHICS

A. Floor Plan Graphics

1. The BAS contractor shall request floor plans to be used as a background for a floor graphic.

2. If the floor plan is too big for the Graphical screen, provide a zoom feature or break the floor down into areas.

3. The floor plan shall, at a minimum, indicate each zone temperature setpoint and current temperature.

B. Equipment Graphics

1. The BAS Contractor shall provide a graphical screen for each individual air handling unit, pumping system, heating system, cooling system and terminal unit. Each graphic shall accurately depict the system components in a schematic format and shall include the setpoint and actual condition of all available temperature, pressure, flow and status points in the system.

2. For each piece of equipment indicated on the graphics, also provide text description of the area or system served. For example, “AHU-1 (East Classrooms)”, “RE-1 (AHU-1 Relief)”, etc.

3. Adjustable or override points shall be clearly displayed and shall be capable of being adjusted without leaving the graphics page.

4. Graphics shall be saved in an industry-standard format such as BMP, JPEG, PNG, or GIF. Web-based system graphics shall be viewable on browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no plug-in or shall only require widely available no-cost plug-ins (such as Active-X or Adobe Flash). Ownership of the graphics software (including tools required for creating, editing and viewing) shall be solely assigned to the building owner. The installing contractor shall not retain ownership of the graphics software, any required licenses or associated data.

5. The installing contractor shall furnish a complete library of standard HVAC equipment graphics such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. This library also shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. The library shall be furnished in a file format compatible with the graphics generation package program.

2.6 STANDARD APPLICATION PROGRAMS

A. Morning warm up:

1. The HVAC system shall start at a predefined/calculated time prior to the system entering the occupied cycle of operation to facilitate the raising or lowering of the building temperature to bring the building back to occupied temperature. Outside air dampers shall be closed with the return air dampers fully open. VAV boxes shall modulate to their fully open position. In heating mode, all hot water coil control valves shall modulate to the fully open position and override any discharge air temperature setpoints. Air handling systems shall be brought on in stages to avoid overloading the pumping system(s).

B. Optimal start:

1. The system shall calculate the optimal time to start the morning warm up or cool down process to assure that the building reaches occupied temperature as close to the occupied time as possible.

C. Event mode:

1. The system shall calculate the optimal time to start to facilitate the raising or lowering of the building temperature to bring the building back to occupied temperature. The outside air damper shall modulate towards its increased minimum position.

D. Demand control ventilation:

1. The outside air damper shall modulate toward the increased minimum position whenever the indoor CO_2 concentration exceeds setpoint (800 ppm) and the indoor/outdoor differential exceeds setpoint (200 ppm). When the indoor CO_2 level is reduced to below 500 ppm, the outside air damper shall return to its reduced minimum position.

E. Scheduled occupied/unoccupied:

1. The system shall enter occupied or unoccupied cycle as determined by a time of day, day of week schedule. Unoccupied mode shall include setback/setup temperature setpoints.

F. Occupancy Stand-by:

1. The system shall enter a stand-by mode during the scheduled occupied cycle as determined by a room occupancy sensor. Room temperature setpoint shall remain at the occupied setting while VAV boxes are allowed to modulate to the fully closed position when the space temperature is satisfied. Terminal unit outside air dampers shall be allowed to fully close in stand-by mode. The room occupancy sensor is furnished and installed by the Electrical Contractor (or by the BAS Contractor if indicated in the control sequence). Interlock wiring between the sensor and the controller is furnished and installed by the BAS Contractor.

G. Sensed occupied/unoccupied:

1. The fan shall start upon activation from the room occupancy sensor. After ten (10) minutes of inactivity (adjustable), the room occupancy sensor shall shut the fan off and return to unoccupied status. The room occupancy sensor is furnished and installed by the Electrical Contractor (or by the BAS Contractor if indicated in the control sequence). Interlock wiring between the sensor and the controller is furnished and installed by the BAS Contractor.

H. Enthalpy economizer:

1. Whenever the outdoor air total energy is below the return air total energy and there is a call for cooling the system shall allow the outside air dampers to modulate prior to allowing mechanical cooling to activate.

2. The outside air damper shall return to minimum whenever the outside air total energy is above the return air total energy.

3. Whenever the system is operating in economizer mode, air handling unit chilled water and hot water coil control valves shall remain closed. Direct expansion cooling systems shall be disabled.

4. Provide fault detection and diagnostics (FDD) in accordance with IECC.

I. Dead band:

1. Where used to control both heating and cooling, zone temperature controls shall provide a temperature range or dead band within which the supply of heating and cooling energy to the zone is capable of being shut off or reduced to a minimum.

J. Night set-back:

1. Whenever the system is in the unoccupied cycle the room heating temperature setpoint shall be set-back to a reduced night temperature. The night set-back temperature shall be globally or individually set through the BAS.

K. Night set-up:

1. Whenever the system is in the unoccupied cycle the room cooling temperature setpoint shall be set-up to an increased night temperature. The night set-up temperature shall be globally or individually set through the BAS.

L. Supply air reset:

1. The system shall reset the supply air temperature setpoint based on the reheat coil valve position of each vav box served by the system. The DDC control program shall reset the supply air temperature from 55 deg. F. to 65 deg. F. The supply air temperature setpoint shall be reset up whenever all reheat coil valves are open at least 15%, The supply air temperature setpoint shall be reset down whenever any one of the reheat coil valves is fully closed.

M. Static pressure reset:

1. The system shall reset the static pressure setpoint based on the damper position of each vav box served by the system. The DDC control program shall gradually reset the static pressure setpoint down whenever all vav boxes are no more than 75% open. The DDC control program shall gradually reset the static pressure setpoint up whenever any vav box reaches 90% open.

2. The static pressure shall reset between minimum and maximum setpoints in increments of 0.1” water column at 10-minute intervals. Obtain minimum and maximum static pressure setpoints from the balancing contractor.

N. Hot water reset (demand control - condensing boilers):

1. The system shall reset the hot water temperature setpoint based on heating coil valve position of each heating unit served by the system. The DDC control program shall reset the hot water supply temperature and modulate between minimum and maximum setpoints indicated in the control sequence. The hot water supply temperature setpoint shall be reset down whenever all heating coil valves are no more than 75% open. The hot water supply temperature setpoint shall be reset up whenever any one of the heating coil valves reaches 90% open.

2. Upon boiler plant startup, the hot water supply temperature shall be set to 120 deg. F and reset between minimum and maximum setpoints in increments and intervals as recommended by the boiler manufacturer.

O. Pressure differential reset:

1. The system shall reset the pressure differential setpoint based on the automatic control valve position of each heating or cooling unit served by the system. The DDC control

program shall gradually reset the pressure differential setpoint down whenever all control valves are no more than 80% open. The DDC control program shall gradually reset the pressure differential setpoint up whenever any one of the valves reaches 90% open.

2. The pressure differential setpoint shall reset between minimum and maximum setpoints in increments of 0.5 psig at 10-minute intervals. Obtain minimum and maximum pressure differential setpoints from the balancing contractor.

2.7 BUILDING LEVEL SYSTEM CONTROLLERS

A. Provide this type of controller for controlling:

1. Boiler Plant.

2. Air Handling Units.

3. Energy Recovery Units.

4. Integration to auxiliary systems such as Lighting, Power Monitoring, etc.

B. BACnet Compliance: Control units shall use ASHRAE 135 protocol.

C. Modular, comprising processor board with programmable, nonvolatile, random-access memory; and backup power source.

D. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.

E. Stand-alone mode control functions operate regardless of network status. Functions include the following:

1. Global communications.

2. Discrete/digital and analog I/O.

3. Monitoring, controlling, or addressing data points.

4. Software applications, scheduling, and alarm processing.

5. Testing and developing control algorithms without disrupting field hardware and controlled environment.

F. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.

G. All building level system controllers shall be provided with minimum 25% additional capacity for future use. Fully loaded controllers without additional capacity will not be accepted.

H. I/O Interface: Hardwired inputs and outputs may tie into system through controllers.

1. Binary Inputs: Allow monitoring of on-off signals without external power.

2. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.

3. Binary Outputs: Provide on-off low-voltage signal, selectable for normally open or normally closed operation.

4. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA).

5. Universal I/Os: Provide software selectable binary or analog outputs.

2.8 ADVANCED APPLICATION CONTROLLERS

A. Provide this type of controller for controlling:

1. Packaged HVAC Units with integral BACnet controllers.

2. Miscellaneous smaller point count applications that require custom sequences.

B. BACnet Compliance: Control units shall use ASHRAE 135 protocol.

C. Self-contained unit, comprising of processor board with programmable, nonvolatile, random-access memory; integral interface equipment; and backup power source.

D. All advanced application controllers shall be provided with minimum 10% additional capacity for future use. Fully loaded controllers without additional capacity will not be accepted.

E. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.

F. Stand-alone mode control functions operate regardless of network status. Functions include the following:

1. Global communications.

2. Discrete/digital and analog I/O.

3. Monitoring, controlling, or addressing data points.

4. Software applications, scheduling, and alarm processing.

5. Testing and developing control algorithms without disrupting field hardware and controlled environment.

G. I/O Interface: Hardwired inputs and outputs may tie into system through controllers.

1. Binary Inputs: Allow monitoring of on-off signals without external power.

2. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.

3. Binary Outputs: Provide on-off low-voltage signal, selectable for normally open or normally closed operation with three-position (on-off-auto) override switches and status lights.

4. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA).

5. Universal I/Os: Provide software selectable binary or analog outputs.

2.9 APPLICATION SPECIFIC CONTROLLERS

A. Provide this type of controller for controlling:

1. VAV boxes

2. Cabinet Heaters

3. Fans

4. Remote point pickup

B. Controller:

1. BACnet Compliance: Control units shall use ASHRAE 135 protocol.

2. Each Building Controller shall be able to communicate with application specific controllers (ASCs) over the subnetwork to control terminal equipment only.

3. Each ASC shall operate as a stand-alone controller capable of performing its specified control responsibilities independently of other controllers in the network.

4. Each ASC shall be a microprocessor-based, multi-tasking, real-time digital control processor.

5. Each ASC shall include all point inputs and outputs necessary to perform the specified control sequences. The ASC shall accept input and provide output signals that comply with industry standards. Controllers utilizing proprietary control output signals shall not be acceptable. Outputs utilized either for two-state, or proportional control, allowing for additional system flexibility.

6. All application specific controllers shall be provided with minimum 10% additional capacity for future use. Fully loaded controllers without additional capacity will not be accepted.

7. Communication. Each controller shall perform its primary control function independent of the network and other controllers. Controllers that depend on communication to master controllers or revert to a fail-safe mode of operation during subnetwork interruption are not acceptable.

C. Control Algorithms. The controller shall receive its real-time data from the Building Controller time clock to ensure Secondary Network continuity. Each controller shall include algorithms incorporating proportional, integral and derivative (PID) gains for all applications. All PID gains and biases shall be field-adjustable at the operator workstation.

D. Control Applications. Operating programs shall be field-selectable for specific applications. In addition, specific applications may be modified to meet the user's exact control strategy requirements, allowing for additional system flexibility. Controllers that require factory changes of all applications are not acceptable.

E. Programmability. Application Specific Controllers shall be programmable, using software provided by the BAS manufacturer. Software shall be field-installable on any standard laptop or Portable Operator’s Terminal. Program language shall be text-based and allow up to 200 lines of code for programming. Programming shall allow for changing sequence of operation, commanding and releasing points, additional monitoring, and command priority management within the Application Specific Controller.

F. Memory.

1. Provide each ASC with sufficient memory to accommodate point databases, operating programs, local alarming and local trending. All databases and programs shall be stored in non-volatile EEPROM, EPROM and PROM, or minimum of 72-hour battery backup shall be provided. The controllers shall be able to return to full normal operation without user intervention after a power failure of unlimited duration.

G. Upon replacement, new ASCs shall recover control function and site-specific defaults automatically and resume normal operation.

2.10 CONTROLLER ENCLOSURE CABINETS

A. Provide enclosure cabinets with brackets suitable for either wall or floor mounting for each air handling system, boiler plant, or chiller plant, and for each miscellaneous control system. All building level system controllers, advanced application controllers, and application specific controllers that are not unit-mounted (i.e. VAV boxes, etc.) shall be located within an enclosure cabinet and mounted in a mechanical room, janitor closet, data closet, or other unoccupied service-related room.

B. Locate enclosure cabinet adjacent to the system served.

C. Fabricate enclosures of 14 gauge furniture-grade steel or 6063-T5 extruded aluminum alloy, totally enclosed on all four sides, with hinged door and keyed lock, with manufacturer's standard shop-painted finish and color.

D. Enclosure cabinets shall be U.L. listed for use with line voltage devices.

E. All indications and adjustments contained within the enclosure cabinet shall be clearly labeled as to their respective use by a bake-lite label permanently affixed to the panel.

2.11 ELECTRONIC SENSORS AND SWITCHES

A. Room Temperature Sensors

1. Flush Plate Temperature Sensors – Wired: Where called for in the sequences or on the drawings, provide sensors with stainless steel plate face flush mounted in the wall.

2. Plain Space Temperature Sensors – Wired: Where called for in the sequences or on the drawings, provide sensors with plain covers and manual override button.

3. Digital Display Space Temperature Sensors – Wired: Where called for in the sequences or on the drawings, provide sensors with digital displays, setpoint adjustment, and manual override button.

4. Wireless Space Temperature Sensors: Where called for in the sequences or on the drawings, provide wireless sensors with plain or digital display covers as indicated. Digital display type shall include setpoint adjustment and manual override button.

5. The sensing element for the space temperature sensors shall be thermistor type providing the following.

a.	Element Accuracy:	+ /- 1.0°F
b.	Operating Range:	55 to 95°F
c.	Set Point Adjustment Range:	55 to 95°F
d.	Calibration Adjustments:	None required
e.	Auxiliary Communications Port:	As required

6. The digital display shall provide the following.

a. Display of temperature setpoint with numerical temperature values.

b. Display of room temperature with numerical temperature values.

c. Display of active occupied/unoccupied status.

d. Occupied/unoccupied override.

e. User ability to adjust the temperature setpoint by +/- 3°F.

7. Wireless space temperature sensors shall be 10K Ohm Thermistor or equivalent type providing the following.

a.	Accuracy:	+ .5°F
b.	Operating Range:	55 to 95°F
c.	Monitoring Range:	55 to 95°F

d. Battery life: Minimum 10 years

e. Auxiliary Communications Port: as required

8. All sensors shall be mountable to and fully covering a standard 2x4 electrical junction box without the need for an adapter wall plate.

9. Provide the following options as they are called for in the sequences or on the drawings:

a. Setpoint adjustment. The setpoint adjustment function shall allow for modification of the temperature by the building operators. Setpoint adjustment may be locked out, overridden, or limited as to time or temperature range through software by an authorized operator at any central workstation.

b. Occupied/unoccupied override. An override button shall initiate override of the night setback mode to normal (day) operation when activated by the occupant and enabled by building operators. The override shall be limited to two (2) hours (adjustable.) The override function may be locked out, overridden, or limited through software by an authorized operator at any central workstation.

B. Space Humidity Sensors

1. Space humidity sensors shall have the same appearance as the space temperature sensors. Humidity elements shall measure relative humidity with a +/- 2% accuracy over the range of 10 to 90% relative humidity. Humidity element shall be an IC (integrated circuit) sensing element. Humidity sensing elements shall be removable and field replaceable if needed.

C. Thermistor Temperature Sensors and Transmitters:

1. Enclosure shall be a color contrasting NEMA Type 4X/IP65 including a NEMA 4X/IP65 cable gland and a 1/2 NPT conduit adapter fitting a tool-free access.

2. Accuracy: Plus or minus 0.3 deg. F at 77 deg. F calibration point.

3. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.

4. Averaging Elements in Ducts: 10 feet long, flexible, true averaging, one continuous RTD element across entire length; use where prone to temperature stratification or where ducts are larger than 10 sq. ft.

5. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.

6. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.

D. Pressure Transmitters/Transducers:

1. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.

2. Enclosure shall be a color contrasting NEMA Type 4X/IP65 including a NEMA 4X/IP65 cable gland and a 1/2 NPT conduit adapter fitting a tool-free access.

    a. Accuracy: Plus or minus 0.04 inches wg full scale.

    b. Output: 4 to 20 mA and VDC multi-range.

    c. Building Static-Pressure Range: 0 to 0.25-inch wg.

    d. Duct Static-Pressure Range: 0 to 5-inch wg.

3. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150 psig operating pressure; linear output 4 to 20 mA.

4. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig; linear output 4 to 20 mA.

5. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.

6. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.

E. Room sensor accessories include the following:

1. Insulating Bases: For sensors located on exterior walls.

F. Water Flow Meters

1. Insertion turbine type flow meter with isolated 4-20 mA and 0-10 Vdc analog output signals which are linear with the flow rate; electronic impedance sensing. Accuracy of 0.5% of reading at calibrated velocity, 1% of reading from 3-30 fps. Onicon F-1211, or equal.

G. CO_2 Sensors

1. Enclosure shall be a color contrasting NEMA Type 4X/IP65 including a NEMA 4X/IP65 cable gland and a 1/2 NPT conduit adapter fitting a tool-free access.

2. Provide indoor air quality sensors to monitor Carbon Dioxide (CO_2) and/or Volatile Organic Compound (VOC) levels.

3. The CO_2 sensor shall be of microprocessor-based non-dispersive infrared type.

4. The CO_2 sensors shall have dual channel calibration and accuracy of plus/minus 3 percent of the reading, plus/minus 50 ppm so that no calibration will be required.

5. The units shall be wall or duct mounted type as indicated on plans and in the sequence of operation.

6. Wall mounted sensors shall be provided with white plastic cover, without LED indicators.

7. Duct mounted sensors shall be provided without the need for a separate aspirator box.

8. The VOC sensor shall have automatic self-calibrating capability to ensure accuracy.

9. The sensor shall meet the following requirements:

a.	Operating voltage:	24 Vac +/- 20%
b.	Frequency:	50/60 Hz
c.	Power consumption:	max. 6 VA
d.	CO_2 measuring range:	0 – 2000 ppm
e.	Tolerance:	+/- 50 ppm
f.	Output:	0 – 10 Vac
g.	Calibration:	dual channel calibration
h.	VOC measurement range:	0 – 10V VOC

H. Digital Timer Switches

1. Pushbutton operation with digital LCD display, runtime adjustment, and timer countdown. Wattstopper TS-400-24 or approved equal.

2.12 STATUS SENSORS

A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch w.g.

B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig, piped across pump.

C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.

D. Voltage Transmitter (100 to 600V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.

E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.

F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.

G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 0-10V dc, feedback signal.

H. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.

2.13 GAS DETECTION EQUIPMENT

A. Manufacturers: Ebtron, Inc., Honeywell International Inc., MSA Canada Inc., TSI Inc., Vaisala, Vulcain Inc.

B. Wall Monitor and Display: Provide a wall mounted display unit within or directly outside the monitored space in a NEMA 4X enclosure. The display shall show the real time reading of the remote sensor. It shall come with an audible and visual alarm with an adjustable trip point and silence button. The wall monitor shall be able to output to the BAS via BACnet connection.

C. Carbon Monoxide Detectors: Single or multichannel, dual-level detectors using solid-state plug-in sensors with a 3-year minimum life; suitable over a temperature range of 32 to 104 deg. F and calibrated for 0-100 ppm with two (2) factory-calibrated alarm levels at 50 and 100 ppm. Quantity as required for the area and space volume served.

D. Carbon Dioxide Sensor and Transmitter: Single detectors using solid-state infrared sensors; suitable over a temperature range of 23 to 130 deg F and calibrated for 0 to 2 percent, with continuous or averaged reading, 4-20 mA output, or alarm contacts, for wall mounting.

E. Nitrogen (NO_x) Sensor and Transmitter: Single detectors using solid-state infrared sensors; suitable over a temperature range of 23 to 130 deg F and calibrated for 0-10 ppm, with continuous or averaged reading, 4-20 mA output, or alarm contacts, for wall mounting. Quantity as required for the area and space volume served.

2.14 COMBINATION DAMPER AND AIRFLOW MEASURING STATION

A. Combination airflow measuring station and airfoil blade control damper. Tamco/Ebtron AIR-IQ2, Ruskin AiQ-TD-50, Greenheck AMD-42-TD, or pre-approved equal.

B. Factory-assembled, fifteen-inch (15”) long aluminum sleeve housing the control damper and air flow measuring dispersion tubes.

C. Damper blades shall be extruded aluminum (6063T6), six-inch (6”) deep, extruded silicone blade seals, with mounting fasteners. Damper leakage shall be AMCA rated for Leakage Class 1A, 3 CFM/sq. ft. at 1” water gauge static pressure. Air leakage data shall be certified under the AMCA Certified Ratings Program.

D. Dampers for proportioning control shall have opposed blade action. Dampers for two position, open-closed control shall have parallel blade action.

E. Low voltage modulating damper actuator as hereinafter specified.

F. Airflow measuring station shall be thermal dispersion or differential pressure airflow measuring device with anodized aluminum sensing tubes or blades, remote-mounted transmitter/controller, UL listed plenum-rated cables, 100-3,000 fpm measuring range, airflow accuracy of +/- 2%, line voltage (120V) or low voltage (24V) power to controller, two analog outputs one BACnet MS/TP connection; BTL listed; UL listed.

G. Dampers that are serving chlorinated or other corrosive environments shall be of appropriate materials and/or coatings.

2.15 FREEZE PROTECTION THERMOSTATS

A. Snap-acting, single-pole, single-throw, automatic reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point. Switch shall automatically reset three (3) times before sending an alarm signal to the BAS.

1. Bulb Length: Minimum 20 feet.

2. Accuracy: Plus or minus 0.9 deg. F.

3. Quantity: One thermostat for every 20 sq. ft. of coil surface.

4. Location: Downstream/discharge side of the heating coil.

2.16 CONTROL DAMPERS

A. Control dampers shall be furnished by the BAS Contractor but shall be set in place by the Mechanical Contractor. Dampers shall be of the balanced type with a maximum blade width of 8" and length of 48". Damper frames shall be galvanized sheet metal or aluminum with nylon or sintered bronze oil impregnated bearings.

B. Dampers for proportioning control shall have opposed blade action. Dampers for two-position, open-closed control shall have parallel blade action.

C. Damper blades shall be airfoil blade type and have interlocking edges with compressible seals on both blade edges and ends. Dampers, when closed, shall be guaranteed by the manufacturer to meet Class 1A leakage requirements, 3 CFM/sq. ft. at 1" water gauge static pressure. Ruskin CD60, Greenheck VCD-33, or approved equal.

D. Dampers installed in ductwork serving pool systems or other corrosive environments shall be of fully stainless-steel construction.

2.17 ACTUATORS

A. Electronic Actuators: Spring-return, direct-coupled type.

1. Valves: Size for torque required for valve close off at maximum pump dynamic differential pressure.

2. Dampers: Size for running torque calculated as follows:

a. Parallel-Blade Damper: 7 inch-lb./sq. ft. of damper.

b. Opposed-Blade Damper: 5 inch-lb./sq. ft. of damper.

c. Dampers with 2 to 3-inch w.g. of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.

d. Dampers with 3 to 4-inch w.g. of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.

3. Coupling: V-bolt and U-shaped, toothed cradle.

4. Overload Protection: Electronic overload or digital rotation-sensing circuitry.

5. Fail-Safe Operation: Mechanical, spring-return mechanism to drive controlled device to an end position on loss of power. Electronic fail-safe shall incorporate an active balancing circuit to maintain equal charging rates among the super capacitors. The power fail position shall be proportionally adjustable between 0-100 percent in 10 degree increments with a 2 second operation delay.

a. Heating valves shall fail open.

b. Heating valves on terminal units (VAV's, cabinet heaters, unit heaters, etc.) may fail to last position.

c. Three-way heating valves on radiant floor systems shall fail to the bypass position.

d. Hot water system bypass valves shall fail closed.

e. Outside air and exhaust air dampers shall fail closed.

f. Return air dampers shall fail open.

6. Power Requirements (Two-Position Spring Return): 24V ac.

7. Power Requirements (Modulating): 120V ac or 24V ac.

8. Proportional Signal: 0-10V dc or 4-20 mA, and 0-10V dc position feedback signal.

9. Temperature Rating: Minus 22 to plus 122 deg. F.

10. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg. F.

11. Actuators installed outside of the building shall be enclosed within weatherproof enclosures sealed watertight.

2.18 CONTROL VALVES (PRESSURE INDEPENDENT TYPE)

A. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.

Control valves shall be factory pre-set for the flow rates scheduled on the plans and labeled for each specific piece of equipment served.

B. Control valve assemblies shall be provided and delivered from a single manufacturer as a complete assembly.

C. Pressure Independent Ball Valves (1”-6”): NPS 2 and smaller 360 psig body rating; NPS 2-1/2 through NPS 6 ANSI 125 Class B. Forged brass body; stainless steel ball and blowout proof stem; Teflon ball seats and dual EPDM O-rings. Belimo ePIV or pre-approved equal ball control valve. Globe and/or gate style valves are not acceptable.

1. Sizing: 5-psig maximum pressure drop at design flow rate.

2. Flow Characteristics: Two-way valves shall have equal percentage characteristics.

3. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head.

4. An integrated ultrasonic flow meter (accuracy plus/minus 2 percent) shall provide analog flow feedback. The valve shall reposition to maintain the required flow with a plus/minus 5 percent accuracy over a differential pressure range of 1 to 50 psig.

5. Real-time data and configuration of valve operating parameters shall be available via BACnet, MODBUS or HTTP. Monitored points shall include true flow and valve position.

6. Glycol Monitoring: The control valves serving the hot water coil for AHU-1 shall be Belimo Energy Valve or approved equal. The control valve assembly shall incorporate an algorithm to automatically calculate the glycol concentration and be readable by a local device, BACnet or MODBUS.

D. Pressure Independent Ball Valves (3/4” and smaller; less than 10 gpm): Forged brass body with stainless steel blowout proof ball and stem, Teflon PTFE ball seats, dual EPDM O-rings, and NPT female ends. Two internal P/T ports shall be incorporated for differential pressure verification. Replaceable cartridges are not permitted. Belimo PIQCV, Victaulic Series 7MP, or pre-approved equal ball control valve. Globe and/or gate style valves are not acceptable.

1. Rating: 360 psig body and 212 deg F operating conditions.

2. Sizing: 5-psig maximum pressure drop at design flow rate, to close against pump shutoff head.

3. Flow Characteristics: Two-way valves shall have equal percentage characteristics.

2.19 CONTROL VALVES (SYSTEM BYPASS AND 3-WAY VALVES)

A. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.

B. Hydronic system globe valves shall have the following characteristics:

1. NPS 2” and Smaller: Class 125 and 250 degrees F bronze body, rising stem, renewable composition disc, and screwed ends with back-seating capacity repackable under pressure.

2. NPS 2-1/2” and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.

3. Internal Construction: Replaceable plugs, stainless-steel or brass seats.

4. Sizing: 3-psig maximum pressure drop at design flow rate.

5. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head.

C. Butterfly Valves: 200-psig, 150-psig maximum pressure differential, cast-iron or ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.

1. Body Style: Full lug

2. Disc Type: Nickel-plated ductile iron.

3. Sizing: 3-psig maximum pressure drop at design flow rate.

D. Three-way Terminal Unit Control Valves: Forged brass body with stainless steel blowout proof ball and stem, Teflon PTFE ball seats, dual EPDM O-rings, and NPT female ends.

1. Rating: 600 psig body and 250 deg F operating conditions.

2. Sizing: 5-psig maximum pressure drop at design flow rate, to close against pump shutoff head.

3. Flow Characteristics: Three-way valves shall have linear characteristics.

E. Hot Water System Bypass Valves: Valves shall be sized for minimum 5-psig pressure drop, maximum 8-psig, based on the greater of the system pump minimum flow or the boiler minimum flow requirement as indicated by the boiler manufacturer.

PART 3 - EXECUTION

3.1 GENERAL

A. All necessary equipment, labor and materials not specifically indicated or specified, but necessary to complete work, are to be provided as part of the contract.

B. Install all control equipment, accessories, wiring, and piping in a neat and workmanlike manner. All control devices must be installed in accessible locations.

C. All sensors and control devices that are to be installed within a classified/rated area shall be provided with the appropriate rating for the space in which they are located.

D. Provide all electrical relays and wiring, line and low voltage, for control systems, devices and components. Install all wiring in accordance with electrical sections (Division 26) of this specification and the National Electrical code.

E. Control panels serving equipment fed by emergency power shall also be served by emergency power.

F. Controller enclosure cabinet locations shall be coordinated with the Electrical Contractor and other trades.

G. The BAS Contractor shall coordinate all work as applicable and appropriate with the Fire Alarm Contractor and the equipment manufacturers. The BAS Contractor shall be responsible for any and all re-work required due to a lack of field coordination with other trades and equipment manufacturers.

3.2 INSTALLATION

A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.

B. Connect and configure equipment, controllers and software to achieve sequence of operation specified.

C. Verify final location of room temperature sensors, humidity sensors, switches, and other exposed control devices with the Owner based on the suggested locations shown on the drawings and room details, as well as any wall-mounted equipment, prior to installation. Install all devices per ADA requirements.

D. Field locate all control panels and verify locations with the Owner prior to installation. Coordinate requirements with the Electrical Contractor.

E. Coordinate all thermal well location requirements with the Mechanical Contractor.

F. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. All sensor and output wiring shall be shielded cable or per manufacturers specifications which must be furnished upon request.

B. The field wiring connections of all field-mounted sensors shall be adequately protected by a junction box mounted at the point of measurement.

C. In addition to requirements of electrical sections (Division 26), all exposed low voltage wiring (less than 120 V) provided by this Contractor shall be enclosed in conduit. All 120 volt wiring shall be enclosed in EMT conduit. No flexible conduit shall be allowed for 120 volt wiring.

D. Low voltage wiring exposed along a wall within a finished space shall be enclosed with metal wiremold. See Division 26 specifications for requirements.

E. Separate conduit systems shall be provided for low voltage and line voltage wiring.

F. All wiring and conduit shall be secured at regular intervals and run parallel with the lines of the building.

G. The installation of conduit of any type, low or line voltage, through any type of ductwork is strictly prohibited.

3.4 CONTROL VALVES

A. All temperature control valves furnished by the BAS Manufacturer are to be installed by the Mechanical Contractor under the coordinating control and supervision of the BAS Contractor in locations shown on plans or where required to provide specific sequence of control.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.

2. Test and adjust controls and safeties.

3. Test calibration of controllers by disconnecting input sensors and stimulating operation with compatible signal generator.

4. Test each point through its full operating range to verify that safety and operating control set points are as required.

5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.

6. Test each system for compliance with sequence of operation.

7. Test software and hardware interlocks.

C. DDC Verification:

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.

2. Check instruments for proper location and accessibility.

3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.

4. Check instrument tubing for proper fittings, slope, material, and support.

5. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.

6. Check temperature instruments and material and length of sensing elements.

7. Check control valves. Verify that they are in correct direction.

8. Check DDC system as follows:

   a. Verify that DDC controller power supply is from emergency power supply, if applicable.

   b. Verify that wires at control panels are tagged with their service designation and approved tagging system.

   c. Verify that spare I/O capacity has been provided.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.6 ADJUSTING

A. Calibrating and Adjusting:

1. Calibrate instruments.

2. Make three-point calibration test for both linearity and accuracy for each analog instrument.

3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.

4. Control System Inputs and Outputs:

   a. Check analog inputs at 0, 50, and 100 percent of span.

   b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.

   c. Check digital inputs using jumper wire.

   d. Check digital outputs using ohmmeter to test for contact making or breaking.

   e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.

5. Flow:

a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.

b. Manually operate flow switches to verify that they make or break contact.

6. Pressure:

a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.

b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.

7. Temperature:

a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.

b. Calibrate temperature switches to make or break contacts.

8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.

9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.

10. Utilize proper diagnostic and test instruments for calibration and adjustment of system.

11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature and humidity set points. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to demonstrate and train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls as specified below.

1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.

2. Schedule training with owner with at least 3 days' notice.

3. Provide operator training on data display, alarm and status descriptors, requesting data, execution of commands, and request of logs. Include a minimum of 12 hours dedicated instructor time on-site.

4. Provide screen capture software with audio capture for Owner use.

5. Additional instruction time as deemed necessary by the Owner shall be obtained from the BAS Contractor on a negotiated basis with the Owner.

END SECTION 25 09 00

SECTION 25 09 93 - CONTROL SEQUENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the contract, including General and Supplementary Conditions and Division 01 specification sections apply to work of this Section.

1.2 RELATED WORK

A. 25 09 00 Building Automation System

1.3 GENERAL ITEMS

A. The BAS and Mechanical Contractors shall reference Section 25 09 00 for the requirements of all control programs and controls related hardware and devices.

B. All systems shall reference global outdoor air temperature, enthalpy, and CO_2 sensors.

C. Design cooling setpoint shall be 75ºF. Design heating setpoint shall be 70ºF. All setpoints shall be user adjustable, but **+/- 3°F range limits shall be implemented**. Cooling setpoint low limit is recommended at 73ºF and heating setpoint high limit is recommended at 71ºF to maintain a minimum 2°F deadband.

D. Unoccupied setback and setup temperatures are recommended at 65ºF setback in heating mode and 78ºF setup in cooling mode.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 UNIT HEATERS

A. Control programs

1. Scheduled occupied/unoccupied.
2. Dead band.
3. Night set-back.

B. Control devices for each unit.

1. Application Specific Controller.
2. Room temperature sensor – Stainless steel flush plate type.

3. Two-way heating coil valve and modulating actuator.

4. Outputs for fan motor control.

C. Control Sequence.

1. The DDC control program shall cycle the unit fan motor and modulate the heating coil valve to maintain room temperature setpoint.

3.2 CABINET HEATER

A. Control programs

1. Scheduled occupied/unoccupied.

2. Dead band.

3. Night set-back.

B. Control devices for each unit.

1. Application Specific Controller.

2. Room temperature sensor – Stainless steel flush plate type.

3. Two-way heating coil valve and modulating actuator.

4. Outputs for fan motor control.

C. Control Sequence.

1. The DDC control program shall cycle the unit fan motor and modulate the heating coil valve to maintain room temperature setpoint.

3.3 CONVECTOR

A. Control programs

1. Scheduled occupied/unoccupied.

2. Dead band.

3. Night set-back.

B. Control devices for each unit.

1. Application Specific Controller.

2. Room temperature sensor – Stainless steel flush plate type.

3. Two-way heating coil valve and modulating actuator.

C. Control Sequence

1. The DDC control program shall modulate the heating coil valve to maintain room temperature setpoint.

3.4 VARIABLE AIR VOLUME BOXES

A. Control programs

1. Occupancy Stand-by.

2. Scheduled occupied/unoccupied.

3. Dead band.

4. Night set-back.

5. Night set-up.

B. Control devices for each unit.

1. Application Specific Controller.

2. Modulating damper actuator for VAV damper in the unit.

3. Room temperature sensor – Digital display type.

4. Discharge air temperature sensor.

5. Two-way heating coil valve and modulating actuator.

6. Interlock with room occupancy sensor furnished by E.C.

C. Control Sequence

1. The DDC control program shall modulate the VAV box actuator and heating coil valve in sequence as required to maintain room temperature setpoint.

2. On a drop in room temperature below setpoint, the air flow shall modulate from maximum to minimum air flow. On a further drop in room temperature, the heating coil valve shall modulate as required to maintain room temperature setpoint but shall not exceed the scheduled leaving air temperature. On a further call for heat, the air flow shall modulate from minimum to maximum air flow, maintaining the scheduled leaving air temperature as required to maintain room temperature setpoint. On a rise in room temperature above setpoint, the reverse shall occur.

3. Whenever the respective system is in cooling mode or economizer, the VAV box shall not be allowed to increase air flow above 30% of maximum when reheating to control space temperature or prevent overcooling.

4. Coordinate minimum and maximum air flow settings with the air balancing contractor.

5. Whenever the discharge air temperature drops below 40 degrees F, the heating coil valve shall fully open, and the BAS shall shut down the respective air handling system.

6. Occupancy Stand-by Cycle:

   a. Minimum ventilation settings shall be disabled and the VAV box shall be allowed to modulate to the 10% open position.

   b. Note: Room temperature setpoint shall not be set back or set up in the occupancy stand-by cycle.

   c. The occupancy stand-by control shall not be implemented on VAV boxes that serve multiple rooms with multiple occupancy sensors.

7. Direct expansion cooling systems:

   a. Coordinate system minimum airflow requirements with the equipment manufacturer to determine total VAV box minimum airflow settings required to prevent coil frosting and/or low limit discharge air shutdown.

3.5 VARIABLE FREQUENCY DRIVES

A. Each variable frequency drive (VFD), both field-installed and packaged equipment OEM drives, shall be fully integrated into the BAS via BACnet communication gateway to allow all information available from the VFD panel to be viewed and all settings and adjustments to be made through the BAS. At a minimum, the BAS shall be arranged to poll VFD for the following information:

1. Motor speed feedback

2. kW

3. kWH

4. VFD fault/trouble

5. Hand-Off-Auto (HOA) Switch Position

6. Total 10 points available

3.6 VARIABLE AIR VOLUME AIR HANDLING UNITS

A. Equipment served

1. AHU-1

2. Associated VFD

3. CCU-1

B. Control programs

1. Morning warm up.
2. Optimal start.
3. Scheduled occupied/unoccupied.
4. Supply air reset.
5. Static pressure reset.
6. Enthalpy economizer.
7. Demand control ventilation.
8. Event mode.
9. Night set-back.
10. Night set-up.

C. Control devices for each unit

1. Building Level System Controller.
2. Combination outside air damper and airflow measuring station and modulating damper actuator.
3. Return air damper and modulating damper actuator.
4. Two-way heating coil valve and modulating actuator.
5. Heating coil entering and leaving water temperature sensors.
6. Outputs to modulate mechanical cooling.
7. Outputs for fan motor speed control.
8. Unit discharge air, return air, and mixed air temperature sensors.
9. Cooling coil discharge air temperature sensor.
10. Return air humidity sensor.
11. CO_2 sensor (return air)
12. CO_2 sensor (outside air)
13. Duct mounted static pressure sensors (quantity as indicated).

14. High limit static pressure sensor.

15. Smoke detector (furnished by E.C.).

16. Filter air pressure drop differential sensor.

17. Fan status feedback.

18. Freeze protection thermostat.

19. Interlock with Evidence Storage Fan (RE-7)

D. Occupied Cycle

1. The unit fan motors shall start and the outside air and return air dampers shall slowly open to provide the minimum outside air airflow whenever the unit is scheduled to the occupied cycle.

2. The DDC control program shall, in sequence, sequence the stages of mechanical cooling, modulate the economizer dampers, and modulate the heating coil valve to maintain discharge air temperature setpoint as calculated by the supply air reset program.

3. There shall be an adjustable deadband or timed delay between stages of cooling to prevent short cycling of the refrigeration compressors.

4. The DDC control program shall modulate the fan speed to maintain duct static pressure setpoint as calculated by the static pressure reset program. Duct mounted static pressure sensors shall be located where indicated on the plans in the supply ductwork.

5. As the DDC control program modulates the fan speed, the outside air and return air dampers shall also modulate to maintain a constant minimum flow of outside air as indicated on the plans and as measured by the airflow measuring station.

E. Dehumidification Cycle

1. Whenever the return air humidity exceeds high limit setpoint the DDC control program shall override the supply air reset program and control to a constant 55 deg. F cooling coil leaving air temperature. VAV box heating coil control valves shall modulate as required to maintain room temperature setpoints.

2. When the return air humidity falls below high limit setpoint the DDC control program shall revert back to the normal supply air reset control.

F. Unoccupied Cycle

1. The fan motors shall cycle intermittently, at night set-back/set-up temperatures, with the outside air damper closed whenever any one of the room sensors calls for heating or cooling. VAV boxes shall be controlled by their respective DDC control program. When all zones have been satisfied the unit shall stop.

G. General

1. The outside air damper shall close whenever the unit fan motors are off.

2. The DDC control program shall modulate the heating coil valve as required to maintain low limit mixed air temperature (65 deg. F.) whenever the unit fan motor is off.

3. The auto reset freeze protection thermostat shall stop the unit fan motor, close the outside air damper, and open the heating coil valve whenever the coil discharge temperature drops below 35 deg. F.

4. In cooling mode, the cooling shall cycle off whenever the discharge air temperature drops below 45 deg. F. Cooling shall be allowed to cycle back on whenever there is enough of a call for cooling to ensure minimum system airflow across the cooling coil is satisfied, or VAV boxes are commanded open to a predetermined minimum airflow setting. Verify minimum system airflow requirements with the equipment manufacturer.

5. The smoke detector shall be located in the return air duct and shall stop the unit fan motors whenever smoke is present.

6. The high limit static pressure sensor shall be located in the supply ductwork near the fan discharge. Upon a rise in static pressure above setpoint (5" W.C.) the DDC control program shall override the "occupied-unoccupied" schedule and stop the unit fan motors.

3.7 ENERGY RECOVERY UNITS

A. Equipment served

1. ERU-1 and RERU-2

2. DF-1 and DF-2

B. Control programs

1. Optimal start.

2. Scheduled occupied/unoccupied.

C. Control devices for each unit

1. Building Level System Controller.

2. Outside air two-position damper actuator for damper furnished with the unit.

3. Exhaust air two-position damper actuator for damper furnished with the unit.

4. Outputs to sequence stages of gas heat in duct furnace.

5. Outputs for fan motor control.

6. Discharge air temperature sensor.

7. CO sensor.

8. NO_x sensor.

9. Building pressure sensor.

10. Airflow proving switch.

11. Smoke detector (furnished by E.C.)

12. Filter air pressure drop differential sensors.

13. Fan status feedback.

D. Control sequence

1. The control shall function so that the energy recovery unit fan motors start whenever the unit control program is indexed to the occupied cycle or whenever the CO or NO_x sensors detect levels exceeding setpoint (35 ppm CO; 1 ppm NO_x).

2. Upon proof of supply airflow, the discharge air temperature sensor shall cycle the burner stages in the gas-fired duct furnace to maintain discharge air temperature setpoint (65 deg.F adj.).

3. The unit shall run for a minimum of five (5) hours per day.

E. Heating Override (ERU-1 and DF-1)

1. The control program shall function so that the radiant floor is the first stage of heat for the space. If the average of the four (4) room temperature sensors drop below setpoint for more than 30 minutes (adjustable), the energy recovery unit shall start, and the duct furnace shall cycle as required until the room temperature setpoint has been reached.

F. Heating Override (RERU-2 and DF-2)

1. The control program shall function so that the unit heaters are the first stage of heat for the space. If the room temperature sensors drop below setpoint for more than 30 minutes (adjustable), the energy recovery unit shall start, and the duct furnace shall cycle as required until the room temperature setpoint has been reached.

G. General

1. The outside air and exhaust air dampers shall close whenever the unit fan motors are off.

2. The supply fan variable frequency drive shall modulate as required to maintain building static pressure setpoint (-0.02” w.c., adjustable).

3. The smoke detector shall be located in the exhaust/return air duct and shall stop the unit fan motor whenever smoke is present.

3.8 ENERGY RECOVERY UNITS

A. Equipment served

1. ERU-2

2. BC-1

B. Control programs

1. Optimal start.

2. Scheduled occupied/unoccupied.

C. Control devices for each unit

1. Building Level System Controller.

2. Outside air two-position damper actuator for damper furnished with the unit.

3. Exhaust air two-position damper actuator for damper furnished with the unit.

4. Two-way heating coil valve and modulating actuator.

5. Heating coil entering and leaving water temperature sensors.

6. Outputs for fan motor control.

7. Discharge air temperature sensor.

8. Building pressure sensor.

9. Airflow proving switch.

10. Filter air pressure drop differential sensors.

11. Fan status feedback.

D. Control sequence

1. The DDC control program shall enable the unit.

2. The unit supply and exhaust fan motors shall start, and the outside air and exhaust air dampers shall open whenever the unit is scheduled to the occupied cycle.

3. The DDC control program shall, modulate the heating coil valve to maintain discharge air temperature setpoint as calculated by the supply air reset program.

E. Heating Override

1. The control program shall function so that the radiant floor is the first stage of heat for the space. If the average of the four (4) room temperature sensors drop below setpoint for more than 30 minutes (adjustable), the energy recovery unit shall start, and the heating coil control valve shall modulate as required until the room temperature setpoint has been reached.

F. General

1. The outside air and exhaust air dampers shall close whenever the unit fan motors are off.

2. The supply fan variable frequency drive shall modulate as required to maintain building static pressure setpoint (-0.02” w.c., adjustable).

3.9 HOT WATER SYSTEM

A. Equipment served

1. P-1 and P-2.

2. Associated VFDs

3. B-1 and B-2

B. Control programs

1. Hot water reset (demand control).

2. Pressure differential reset.

3. Scheduled occupied/unoccupied.

C. Control devices (by BAS Contractor except as noted)

1. Building Level System Controller.

2. BACnet controller (furnished with the hot water boilers).

3. Outputs for pump motor speed control.

4. Pump status feedback.

5. System differential pressure sensor(s).

6. Two-way system bypass valve(s) and modulating actuator(s).

7. System water flow meter.

8. Hot water inlet and outlet temperature sensors at each boiler.

9. Hot water supply and return temperature sensors in piping mains.

10. Outside air temperature sensor.

11. Two-way hot water stop valve and normally open two position actuator for each boiler (furnished with the hot water boilers).

12. Relays for hard-wired boiler system enable.

13. Relays for hard-wired reset signal.

14. Boiler system emergency stop station (one per room entrance).

D. Control Sequence

1. The control shall function so that the lead pump starts whenever the outside air temperature drops below setpoint, or the system is scheduled to the occupied cycle or dehumidification mode of any air handling system. Upon failure of the lead pump the stand-by pump shall start. The lead pump shall rotate as required to maintain equal run time between the pumps.

2. System differential water pressure sensor(s) shall be located where indicated across supply and return mains. The DDC control program shall modulate the variable frequency drive serving the respective lead pump, to maintain system differential water pressure setpoint as calculated by the pressure differential reset program. See Section 250900 for reset program requirements.

3. System flow meter shall be located in the supply main downstream of the system pumps and prior to the first branch piping takeoff. The DDC control program shall modulate the bypass valve(s) as required to prevent the total system flow from dropping below the indicated minimum flow in the piping system. Coordinate minimum system flow setpoint with the boiler manufacturer.

4. The BAS Contractor shall install and wire all remote boiler sensors and boiler controllers as directed by the boiler manufacturer.

5. The Building Level System Controller shall interface with the BACnet controller furnished with the boilers. The BAS Contractor shall map all input, output and alarm points to the OWS to allow remote supervision of all boiler operating parameters. All setpoints shall be able to be modified remotely through the OWS. The boiler manufacturer shall provide BACnet addresses to facilitate mapping of the points by the BAS Contractor.

6. The DDC control program shall enable the boilers whenever the hot water pump is running. Once the boilers are enabled the boiler manufacturer’s controller shall manage all boiler control functions.

7. The boiler control program shall function so that one boiler is designated as the lead boiler. The stop valve serving the lead boiler shall remain open at all times. All other stop valves shall remain closed unless there is a call for the boiler to fire in which case the valve shall open. The lead boiler shall rotate as required to maintain equal run time across all boilers.

8. On a call for heat the lead boiler shall start and modulate the gas burner as required to maintain supply water temperature setpoint as calculated by the supply water reset program. Supply water setpoint shall range from 80 deg. F to 160 deg. F. As additional heating capacity is required additional boilers shall start and modulate in accordance with the manufacturer’s recommendations. The boilers shall be allowed to continue to operate at outside air temperatures above 60 deg. F whenever there is a call for reheat or

dehumidification within the system. Provide boiler control with adequate deadband to prevent excessive cycling of the burner control.

9. Each boiler shall be monitored for the temperature rise across the boiler. If the temperature rise exceeds high limit setpoint that boiler's burner shall modulate back to maintain the temperature rise below setpoint.

10. Field locate and label boiler system emergency stop station(s) per CSD-1 requirements. Activation of the emergency stop shall send an alarm condition alert to the BAS.

11. Coordinate any special operational requirements for systems containing glycol with the boiler manufacturer.

3.10 AIR COOLED COMPRESSOR-CONDENSING UNITS

A. Control programs

1. Scheduled occupied/unoccupied.

B. Control devices for each unit

1. Outputs to modulate mechanical cooling.

C. Control Sequence

1. Furnish and install an interlock with each respective air handling unit. See air handling unit for sequence of operation. Unit shall stop whenever the respective air handling unit is off.

3.11 ROOM AIR CONDITIONING UNIT

A. Control programs

1. Scheduled occupied/unoccupied.

2. Night set-back.

3. Night set-up.

B. Control devices for each unit

1. Advanced Application Controller.

2. BACnet controller (furnished with the unit).

3. Room temperature sensor – digital display type.

4. Interlock with remote mounted compressor condensing unit.

C. Control Sequence

1. The Advanced Application Controller shall interface with the BACnet controller furnished with the unit. The BAS Contractor shall map all input, output and alarm points to the OWS to allow remote supervision of all unit operating parameters. All setpoints shall be able to be modified remotely through the OWS. The unit manufacturer shall provide BACnet addresses to facilitate mapping of the points by the BAS Contractor.

2. The digital control program shall enable the unit. Once the unit is enabled the unit manufacturer's controller shall manage all unit control functions.

3. The unit controller shall cycle the unit fan motor and stages of cooling as required to maintain room temperature setpoint.

3.12 EXHAUST FANS - POWERED BUILDING RELIEF

A. Fans Served

1. RE-1 and RE-2

B. Control programs

1. Scheduled occupied/unoccupied.

C. Control devices for each unit.

1. Building Level Controller (shared with associated air handling unit).

2. Outputs for fan motor speed control.

3. Combination relief damper and airflow measuring station and modulating damper actuator.

4. Building static pressure sensors.

D. Control Sequence

1. The control shall function so that the lead relief fan damper opens, and the unit fan motor starts at minimum speed whenever the building static pressure rises above setpoint.

2. The DDC control program shall modulate the fan motor speed as required to maintain building static pressure setpoint (+0.03" w.c., adj.) and monitor the exhaust airflow rate at the airflow measuring station.

3. When the lead relief fan is at full speed, and the building static pressure rises above setpoint, the lag relief fan shall start at minimum speed and modulate the fan motor speed as required to maintain building static pressure setpoint. On a drop in building static pressure below setpoint (+0.01" w.c., adj.), the opposite shall occur.

4. Where multiple system relief fans pull relief air from a common plenum space, the fans shall be brought on sequentially at minimum speed with a timed delay to prevent sudden negative pressurization of the spaces served.

5. The unit fan motors shall be off whenever the respective air handling unit stops.

6. Provide delayed action control logic and sensors in sufficient quantity to maintain consistent building pressure and limit excessive modulation of the fan.

7. Lead fan designation shall rotate monthly to provide equal run time for each fan.

3.13 ROOF EXHAUST FANS – SCHEDULED OCCUPIED/UNOCCUPIED

A. Fans served

1. RE-3, RE-4, RE-5, and RE-7.

B. Control programs

1. Scheduled occupied/unoccupied.

C. Control devices for each unit.

1. Application Specific Controller.

2. Outputs for fan motor control.

3. Fan status.

4. Exhaust air damper and two position damper actuator.

D. Control Sequence

1. The DDC control program shall open the exhaust air damper and start the unit fan motor whenever the system is scheduled to the occupied cycle.

2. RE-7: Furnish and install an interlock with each respective air handling unit (AHU-1). The DDC control program shall open the exhaust air damper and start the unit fan motor whenever the respective air handling unit is operating. Unit shall stop whenever the respective air handling unit is off.

3.14 ROOF EXHAUST FANS – MANUAL CONTROL WITH UNOCCUPIED OFF

A. Fans served

1. RE-6, RE-8, and RE-9.

B. Control programs

1. Scheduled occupied/unoccupied.

C. Control devices for each unit.

1. Application Specific Controller.

2. Outputs for fan motor control.

3. Fan status.

4. Exhaust air damper and two position damper actuator.

5. Remote digital timer switch.

D. Control Sequence

1. The DDC control program shall open the exhaust air damper and start the unit fan motor whenever the digital timer is activated, and the system is scheduled to the occupied cycle.

2. Upon completion of the timer, the fan shall stop, and the exhaust air damper shall close.

3. The fan shall stop, and the exhaust air damper shall close whenever the system is scheduled to the unoccupied cycle.

4. Install digital timer where indicated on the drawings or as directed by the Owner. Label switch with service.

3.15 CEILING EXHAUST FANS – SCHEDULED OCCUPIED/UNOCCUPIED

A. Fans served

1. CE-1 and CE-2

B. Control programs

1. Scheduled occupied/unoccupied.

C. Control devices for each unit.

1. Application Specific Controller.

2. Outputs for fan motor control.

3. Fan status.

4. Install solid state speed control furnished with the fan.

D. Control Sequence

1. The DDC control program shall start the unit fan motor whenever the system is scheduled to the occupied cycle.

3.16 DESTRATIFICATION FANS

A. Fans served

1. DS-1 through DS-4.

B. Control devices for each unit

1. For each fan, install speed switch furnished with the fan flush mounted in the area served or at location indicated.

3.17 DESTRATIFICATION FANS (HVLS)

A. Fans served

1. HVLS-1 and HVLS-2.

B. Control devices for each unit

1. Application Specific Controller.

2. Upper-level space temperature sensor.

3. Outputs for fan motor speed control

4. Remote-control panel (by fan manufacturer)

5. Room temperature sensor – Plain cover type.

6. Remote 0–60-minute digital timer with pilot light.

C. Control programs

1. Scheduled occupied/unoccupied.

D. Occupied/Unoccupied Cycle

1. The DDC control program shall monitor the temperature near the ceiling as well as the room temperature in the occupied zone.

2. If the temperature near the ceiling is at least 10 degrees higher than the room temperature, the DDC control program shall start the destratification fans and modulate the fan speed as required until the upper and lower temperatures are within 2 degrees of each other.

E. Manual Override

1. The DDC control program shall start the unit fan motor at a predetermined speed and light the pilot light whenever the digital timer is activated.

2. Upon completion of the timer, the fan shall stop, and the pilot light shall be off.

F. General

1. The BAS Contractor shall furnish and install line voltage wiring for the remote-control panel as well as low voltage and/or data cabling required for full control and modulation of the destratification fan(s).

2. Per NFPA 72, all HVLS fans shall be interlocked with the fire alarm system to shut down upon any activation of the fire alarm system. Provide all interlocks as required.

3.18 RADIANT FLOOR

A. Equipment Served

1. IP-1 through IP-7

B. Control programs

1. Scheduled occupied/unoccupied.

2. Night set-back.

C. Control devices for each unit

1. Building Level System Controller

2. Three-way heating control valve and modulating actuator.

3. Outputs for pump motor control.

4. Outside air temperature sensor.

5. Radiant floor supply water temperature sensor.

6. Radiant floor return water temperature sensor.

7. Floor slab temperature sensor.

8. Floor slab sensor display – Digital display type.

9. Room temperature sensor – Stainless steel flush plate type.

10. Room averaging sensors (Minimum of 4 for the Apparatus Bay and a minimum of 2 for the remaining manifolds).

11. Pump status feedback.

D. Control Sequence

1. The DDC control program shall start the in-line pump whenever the outside air temperature drops below 55°F and the system is indexed to the occupied cycle.

2. After the pump starts, the three-way valve shall modulate to maintain setpoint of the room sensor) (70°F adjustable).

3. The supply water temperature to the radiant floor slab shall not exceed 130°F (adjustable).

4. The 3-way valve shall stop flow to the radiant floor whenever the pump is off.

3.19 BUILDING LIGHTING CONTROL

A. Furnish and install relays to allow the BAS to interface with the lighting systems. Relays shall be located in electrical rooms next to lighting panels for connection to individual lighting circuits (see E series drawings).

B. Control of the exterior lighting systems shall be accomplished via the astronomical time clock (sunset and sunrise, adjustable) based on project location latitude and longitude and accounting for daylight savings. Photocell sensors are not allowed.

3.20 GLYCOL FEED SYSTEM MONITORING

A. Equipment served

1. GFS-1

B. Furnish and install relays to allow the BAS to interface with the glycol feed system. The BAS Contractor shall extend wiring to the contacts located within the glycol feed system alarm panel. See Section 23 20 05.

3.21 EQUIPMENT MONITORING (OTHER TRADES)

A. Equipment served

1. Emergency Generator

B. Furnish and install relays to allow the BAS to interface with the emergency generator. The BAS Contractor shall extend wiring to the contacts located within the unit control/alarm panel for monitoring and alarm status at the BAS.

C. Alarm and Monitoring

1. Generator Running Contact.

2. Generator Alarm Contact.

3.22 EMERGENCY POWER

A. All the HVAC equipment will be connected to the emergency power system. Control panels serving the equipment indicated below shall be connected to emergency power equipment branch panels as required. Coordinate with the Electrical Contractor.

B. The BAS shall have the ability to distinguish between utility power and emergency power and provide such information graphically at the OWS.

END SECTION 25 09 93

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SECTION 260500 - ELECTRICAL CONTRACT REQUIREMENTS

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work under this Section.

1.2 APPLICABLE PUBLICATIONS

A. Publications, standards and listing requirements called out in the Sections of this Division of Labor shall form a part of these specifications as if contained herein.

B. The requirements of the Contract Documents, including the General Conditions, and Supplementary Conditions, and Division 01 - General Requirements, apply to this section except as modified herein.

1.3 DESCRIPTION OF WORK

A. Sections included:

1. Section 26 05 00 - ELECTRICAL CONTRACT REQUIREMENTS
2. Section 26 05 01 - PROJECT SPECIAL CONDITIONS
3. Section 26 05 04 - DOCUMENTATION
4. Section 26 05 05 - THROUGH PENETRATION FIRESTOPPING
5. Section 26 05 19 - WIRE AND CABLE
6. Section 26 05 26 - GROUNDING
7. Section 26 05 29 - SUPPORTING DEVICES
8. Section 26 05 34 - RACEWAYS
9. Section 26 05 35 - ELECTRICAL BOXES
10. Section 26 05 37 - LOCATION OF OUTLETS AND EQUIPMENT
11. Section 26 05 53 - ELECTRICAL IDENTIFICATION
12. Section 26 05 73 - ELECTRICAL SYSTEM STUDIES
13. Section 26 09 23 - LIGHTING CONTROLS
14. Section 26 24 13 - LOW VOLTAGE SWITCHBOARDS
15. Section 26 24 16 - PANELBOARDS
16. Section 26 27 02 - MOTOR WIRING
17. Section 26 27 26 - WIRING DEVICES
18. Section 26 27 28 - CIRCUIT AND MOTOR DISCONNECTS
19. Section 26 32 00 - STANDBY ENGINE/GENERATOR SET
20. Section 26 32 38 - GENERATOR CONNECTION BOX
21. Section 26 36 00 - TRANSFER SWITCH
22. Section 26 43 13 - SURGE SUPPRESSION
23. Section 26 51 13 - INTERIOR LIGHTING FIXTURES
24. Section 26 56 29 - EXTERIOR LIGHTING FIXTURES

25. Section 27 10 00 - STRUCTURED CABLING SYSTEM
26. Section 27 51 50 - PAGING SYSTEM
27. Section 28 31 00 - ADDRESSABLE FIRE ALARM SYSTEM

B. Work Included:

1. The work covered by this Division of the specifications includes the furnishing of all labor, materials, tools, equipment, permits, certificates and temporary protection necessary for or incidental to executing and completing the electrical work, communications work, and work on related systems.
2. All work shall be as specified and indicated on the drawings unless specifically excepted on the drawings or herein.
3. Read all other Divisions of the Specifications which are applicable to this work, including the General Conditions section applicable to all bidders.
4. The Electrical Contract Requirements section is a supplement to and not a replacement for the project General Conditions section.
5. In cases of conflict with information in the General Conditions, the more stringent of the contract requirements shall be considered applicable.
6. Prior to submitting bid, call to the attention of the Electrical Engineer any material or apparatus believed to be inadequate or any necessary items or work omitted.
7. Address any questions regarding the interpretation of the plans and/or specifications at least 12 days before the bid opening.
8. The Electrical Engineer reserves the right to interpret his own specifications and plans after bids are received, and to demand that the installation conform to his intent.
9. Failure to become acquainted with existing conditions at the site shall in no way relieve the responsibility for making installation in conformance with plans and specifications without additional cost to the owner.

C. Examination of Plans, Specifications and Site:

1. Before submitting a bid, the bidder shall familiarize himself with all features of the building and site which may affect the execution of his work.
2. No extra payment will be allowed for the failure to obtain this information.
3. If there are omissions or errors in the plans or specifications, they shall be clarified with the architect prior to submitting bid.
4. For all remodeling projects, a site visit to the premises, for the purpose of the noting of all existing conditions which may affect work is required.
5. Knowledge of all existing conditions, which may affect work in a renovation project, shall be included in the preparation of bid.
6. Lack of information on existing conditions shall not be allowed for a valid cause for additional compensation.

D. Codes, Permits, and Inspection Fees

1. All work and materials shall conform in every respect to the current rules and requirements of the National Fire Protection Association, National and State Electrical Codes, Local Codes and Ordinances, Local Utility Regulations and OSHA.
2. Give to the proper authorities all required notices relating to the project, obtain all official permits and licenses required, pay all fees incidental thereto, deliver upon completion of the work and without cost to the Owner all required certificates of inspection and approval.

1.4 RELATED WORK ELSEWHERE

A. Applicable provisions of Division 01: General Conditions shall govern work in this section.

B. All other Divisions of the Specifications which are applicable to or interface with work in Division 26 05 00.

C. Division 26 contractor to furnish and install all boxes, conduit and 120 volt connections for Division 27 and 28 required systems.

D. Division 26 contractor to include all costs for Division 27 and 28 in their bid.

1.5 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

B. Submit shop drawings following Section specific Shop drawing submittal guidelines.

1.6 OPERATION & MAINTENANCE MANUALS

A. Submit operation and maintenance manuals in accordance with Section 26 05 04.

B. Submit operation and maintenance manuals following Section specific shop drawing submittal guidelines.

1.7 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. All materials, equipment and parts are to be new, undamaged and unused of current manufacture.

C. Acknowledges acquaintance with the plans and specifications and their respective requirements.

D. Guarantee that the electrical system has been installed strictly in accordance with the electrical plans and specifications using only the best of materials available, installed in a substantial manner by experienced labor.

E. Various components of the electrical system shall be placed in service prior to completion date as instructed by Owner. This shall not change the guarantee period which shall be one year after acceptance by Owner.

F. Replace and/or repair any items failing from causes of faulty workmanship, materials or design without cost to Owner at any time within one year from date of final acceptance.

1.8 WARRANTY

A. Equipment shall be warranted for a period of not less than 1 year from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

PART 2 - PRODUCTS

2.1 GENERAL

A. It is the intent of these specifications that all the necessary material, apparatus, and devices to complete the installation as specified herein, except such parts as are specifically excepted, shall be provided.

B. If an item is either shown on the plan or called for in these specifications, it shall be considered sufficient of said item in this contract.

C. All sizes given are as minimum.

D. Material and labor shall be first class and workmanlike and to the satisfaction of the Electrical Engineer and shall be subject to inspection test and approval at all times from commencement until acceptance of completed work.

E. Manufacturers shall be responsible for providing material listed by U.L. or other approved agencies, and all governing codes and ordinances.

F. All material must bear U.L. and/or other approved labels where possible.

G. Items specified by catalog number or brand name and approval of shop drawings will not relieve the manufacturer of this responsibility.

2.2 MATERIALS: ALTERNATE MATERIALS

A. Where materials, equipment apparatus, or other products are specified by manufacturer, brand name, and type of catalog number such designation is to establish standards of desired quality and style and shall be the basis of the bid.

B. Substitutions shall not be made unless there are "equals" listed in the specifications or on the plan.

C. Substitutions may be bid as alternates.

D. Burden of proof that materials are equal shall be upon bidder requesting their use; therefore, bidder shall furnish, with their request for approval all supporting data.

E. Assume responsibility for substituted material and state name of manufacturer, type or brand or equipment and addition to or deduction from base bid.

F. Materials and equipment must meet all requirements as to type, quality, function, appearance and physical dimensions shown.

G. Assume responsibility for any costs to other Divisions as a result of the use of alternate materials.

H. Submit supporting data to Architect/Electrical Engineer within 15 days after the bid date.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Equipment Submittal Drawings

1. Within 45 days after a notice to proceed and prior to ordering equipment, furnish to the Electrical Engineer submittal drawings for review (see section 26 05 04).
2. Review of any submittal drawings does not waive any condition of the specifications unless specifically noted thereon.
3. No fabrication or ordering of equipment shall be started until reviewed drawings are returned.

3.2 FIELD MEASUREMENTS

A. Job Drawings

1. Maintain, at the job site, one (1) complete set of up-to-date plans and written specifications, complete with all addenda items.
2. This complete plan and specification set shall be reserved for all field markings to show minor revisions and detailed construction notes.
3. These marked plans shall be returned to the Electrical Engineer prior to contract completion and final payment.
4. Assist the Electrical Engineer in transferring applicable field notes to the project drawings for record purposes.

3.3 DELIVERY, STORAGE AND HANDLING

A. Material on Site and Storage

1. Maintain proper care and storage of material and equipment on site.
2. Any material damaged by rust corrosion, warping, breakage, finish damage, etc. shall be replaced by the Contractor to the satisfaction of the Engineer.

3.4 INSTALLATION

A. Field Change Orders

1. No revisions to the contract price shall be allowed unless such revisions have been authorized in writing by both Owner and the change order submitter.
2. All work completed prior to completion of a written contract change order will not be compensated for by the Owner.
3. Any work item that is proposed to perform, on the basis of a proposed contract adder, must be announced in advance such that time is available for the Architect, Owner and the Electrical Engineer to determine if a change in contract price is allowable.

B. Change Orders

1. Change orders may be requested as a part of this project.
2. Assume the following in regards to change orders:

    a. Work and equipment associated with change orders shall be installed per the specified equipment on this project.
    b. All change orders shall be accounted for on as-built drawings.
    c. Change order additions to special systems where riser diagrams have been furnished, shall be included as a part of the riser diagram.
    d. A break down of all costs associated with the change order is required.
    e. The cost breakdown shall be as follows:

        1) Itemized list of all materials.
        2) Materials shall be priced at Best Column in a national pricing service book.
        3) Cost for subcontractor services.
        4) Subcontractor services shall be shown as actual costs from subcontractor.
        5) Material mark-up.
        6) Maximum allowed is 8%.
        7) Number of hours of labor at standard charge out rate.
        8) Tax on material.
        9) Total change order cost.

3. If equipment or materials are deducted as a part of this change order, credit shall also be shown on change order.

C. Installation: General

1. Connections to Equipment Furnished by Others.

    a. Included in Division 26 are electrical connections to equipment provided by others.
    b. Refer to final shop drawings for equipment provided by other divisions for exact location of electrical outlets and the connections required.
    c. Provide energization to the equipment furnished by other Divisions only at the request of the providing party.
    d. Assume that once the equipment has been started up, that it shall be shut off unless it is requested that it be left on by the providing party.
    e. Only start up and turn on equipment if requested so by the party providing said equipment.
    f. If required, power shall not be activated to the equipment until qualified starting personnel are on site.

g. After making a permanent power connection, the breaker shall be left in an off position and a "hold" tag or some other device be utilized to keep the power turned off to the equipment.

2. Relocating of equipment.

a. Assume responsibility for relocating of all electrical equipment as shown on the drawings.
b. As a part of this relocation, be responsible to:

1) Determine the extent of the electrical work for the existing installation.
2) Disconnect existing electrical equipment and remove all unused equipment from existing area.
3) Install new conduit from existing controls to new equipment.

c. Extend all wiring:

1) Assume responsibility for installing new wire from control panel point to equipment.
2) Do not splice cables.

d. Visit the site prior to bid and bring any specific relocation of equipment questions to the attention of the Owner and Electrical Engineer prior to bidding.

3. Assume responsibility for all requirements pertaining to this relocation.
4. Equipment Access & Location.

a. All equipment, junction and pull boxes, and accessories shall be installed to permit access to equipment for maintenance.
b. Any relocation of conduits, equipment, or accessories required to provide maintenance access shall be accomplished at no additional cost.
c. Equipment shall be installed with ample space allowed for removal, repair or changes to the equipment.
d. Ready accessibility to equipment and wiring shall be provided without moving other equipment which is to be installed or which is already in place.
e. Locate electrical outlets and equipment to fit the details, panels, decorating or finish at the space.
f. The Architect shall reserve the right to make minor position changes up to 10' of the outlets before the work has been installed.
g. Verify door swings before installing room lighting switch boxes and install boxes on the latch side of door unless noted otherwise.
h. Furnish information as to exact location and size of sleeves for openings for new construction.
i. Provide and set in place all required sleeves, inserts, forms, etc. and coordinate this work with all other divisions of work.

5. Cutting and patching.

a. Beams or columns shall not be pierced without permission of the Architect and then only as directed.

b. If any openings are required through walls or floors where no sleeve has been provided, the hole for the sleeve shall be core drilled to avoid all unnecessary damage and structural weakening.
c. Provide all cutting and patching required for complete installation of systems unless specifically noted elsewhere.
d. All new or existing work cut or damaged shall be patched and restored to its original condition.
e. Coordinate the location of sleeves, openings, chases, furred spaces, etc.
f. Provide during the progress of construction all sleeves, hangers and inserts that are to be built into the structure.
g. Provide sleeves for cables passing through masonry, concrete or other similar construction.
h. Sleeves shall be of metal conduit and shall extend completely through the construction.
i. Conduits or cables penetrating smoke or fire barriers must not destroy the barrier's integrity.
j. Grout openings between sleeves and concrete or masonry walls and floors.
k. Pack annular space between sleeves and conduits with fiberglass.
l. Where penetrations occur through fire rated walls or floors, fill space with fire resistive caulk.
m. Wherever cables must pass through fire or smoke rated walls or floors, provide approved, sleeved, foam filled fire stops around cables as manufactured by O.Z., Dow, Square D, or equal.
n. Provide all materials required for patching unless otherwise noted.
o. Where alterations disturb lawns, paving, walks, etc., the surfaces shall be repaired, refinished and left in the condition existing prior to commencement of work.

6. Excavation and backfill.

a. Backfilling of all trenches beneath concrete floor and stair slabs within building shall be accomplished with gravel fill and shall be specially compacted to same density as surrounding area.
b. Lines passing under foundation walls shall have a minimum of 1 1/2 inch clearance.
c. Care shall be taken to insure no disturbance of bearing soil under foundations.

7. Floor mounted equipment.

a. Provide "housekeeping" pads for all floor mounted equipment to be installed, specifically switchboard, generator and transformers.
b. In general, a housekeeping pad shall consist of a concrete base 4" in height extending 3" beyond perimeter of equipment.
c. Do not use the base dimensions shown on the drawings.
d. Base dimensions depend upon final approved equipment shop drawings.

8. Exterior base mounted equipment.

a. Provide concrete pads for all exterior base mounted equipment.
b. In general, this pad shall be an 8" concrete pad extending a minimum of 4" beyond the perimeter of the equipment mounted onto that base.
c. Provide #4 reinforcement rods 12" on center in each direction.

d. Concrete shall be finished smooth and shall be set at an elevation as determined by architect.
e. Provide minimum 12" engineered fill under base.

9. Attachments and supports.

a. Be responsible for proper fittings and support for each item of equipment and materials installed under Division 26.
b. Be responsible for the proper application, installation and location of all necessary and required inserts, supports and anchor bolts.
c. Where same are to be installed by other Divisions of work, supply same to the contractor in whose work they occur with instructions for placement and proper installation.
d. Establish the method and nature and select accessories necessary for proper support appropriate to item and point of attachment with due consideration given to ambient/environmental conditions and service duty.
e. Attachments, supporting devices and accessories shall be specifically designed for the application, suitable for the duty imposed in service and acceptable to the Architect.
f. Attachments shall be made to structural components of the structure in such manner not to jeopardize the integrity of the structure and otherwise consistent with trade practices.
g. Generally, anchors shall be concrete insert type in poured concrete and drilled expansion type in precast concrete.
h. Powder actuated anchors shall not be used in concrete work.
i. Provide all mounting backboards as required to mount electrical and electronic equipment.
j. That equipment which is normally assumed to be mounted on some type of a backboard shall be mounted on backboards provided by Division 26.
k. All mounting backboards used by the contractor shall be 3/4" AC grade marine duty plywood.
l. All plywood shall be painted on both sides and edges with two coats of fire resistant white enamel paint.
m. Provide back mounting panels to meet this specification.
n. Steel channel interior to be painted or galvanized.
o. Exterior conduit mounting channel shall be stainless steel.
p. All sleeves to be furnished and installed by Division 26.

D. Installation: Electrical Service

1. Provide a new three phase, four wire electric service as shown on the contract drawings. The ELECTRICAL CONTRACTOR shall consult with the utility and provide metering equipment, transformer pad and conduit rough-in as required by the utility.

E. Installation: Temporary Electric Distribution

1. Install temporary electric distribution per general requirements, section GR-1.
2. Electric Utility Temporary Service fees shall be included in bid.
3. Temporary power requirements, other than the specified, shall be furnished by the division of work requiring the same.

F. Installation: Trial Usage of Electrical Systems

1. The Electrical Engineer has the privilege of the trial usage of electrical systems or parts thereof for the purpose of testing under load the new installation and learning the operational procedures.
2. The trial usage shall be continued for a length of time as deemed reasonable by the Electrical Engineer and all related costs shall be included in the bid, with the exception of the electrical power cost which will be paid by the Owner.
3. The operations shall be carried out only with the express knowledge and under supervision of the responsible sub-trade who shall not waive any responsibility because of trial usage.
4. While trial usage will be kept to a minimum, it shall not be construed as acceptance by the Electrical Engineer.

G. Installation: Cooperation/Coordination

1. Coordinate and cooperate with other Divisions of work and Owner by scheduling and installing work to facilitate the construction progresses and the Owners use of the building.
2. Any deviation from contract plans shall be approved by the Electrical Engineer before proceeding.
3. Study the plans of other trade divisions of work and to fit work into the work of others in a coordinated manner.
4. Lay out work and be responsible for measurements.
5. Check facilities provided by others which require electrical connections and provide outlets suitably located for them.
6. Take such measurements as may be necessary to assure approved fitting and proper installation of his work and all other work depending thereon.
7. Cooperate with other contractors to avoid complications between the installation of electrical equipment and equipment installed by others.

H. Installation: Finish and Painting

1. Equipment and materials such as transformers, panels and switches, shall be furnished with the manufacturer's standard finishes, consisting of a prime coat and baked enamel finish coat, unless otherwise noted.
2. Roof mounted equipment and other exterior materials including support hardware shall have a factory or field applied prime coat and finish coat of color selected by the Owner's Representative.
3. In general painting will be done by other trades. Assume responsibility to coordinate work with the painters so that all equipment is installed prior to painting.
4. Assume responsibility for additional expense required to paint support channels, panel trims, flush junction box covers, fixture hangers and other electrical devices not in place prior to normal routine painting.
5. An undamaged finish is required on all equipment.
6. If finish becomes rusted, corroded, scratched, or flaked during storage or installation, be responsible for refinishing the equipment to the satisfaction of the Architect.
7. Finish painting on the job site is not required by the electrical contractor, except where noted.
8. Refer to other areas of this Division 26 for painting of equipment furnished by the Division 26.

9. Where painting is required to be done by the electrical contractor, the painting shall be done in accordance with the painting portion of the general specification.

I. Installation: Damage to Other Work

1. Assume responsibility for all damages resulting from the execution of work under Section 26 05 00.
2. Assume responsibility to adequately protect Division 26 work at all times.
3. All damages resulting from their operations shall be repaired, or the damaged portions replaced by the party originally performing the work (to the entire satisfaction of the Architect), and all cost thereof shall be borne by those responsible for the damage.

J. Installation: Clean-Up

1. At all times, keep the premises free from excessive accumulation of waste materials or rubbish resulting from work, including tools, scaffolding, and surplus materials and leave work room or it's equivalent, clean.
2. In case of dispute, the Architect may order the removal of such rubbish and charge the cost to the responsible Division of work as determined by the Architect.
3. At the time of final clean-up, all fixtures and equipment shall be thoroughly cleaned and left in proper conditions for their intended use.

K. Installation: Drawing Schedules and Details

1. The electrical drawings include a number of standard and job specific details.
2. These details may or may not be specifically referenced on the drawings and in the specification.
3. Assume that even if the detail is not specifically referenced, that it shall apply to this project. (As an example, if a detail is shown for the exterior mounted receptacles, but the detail is not referenced from the plan sheets, the contractor shall assume that all exterior mounted receptacles shall be installed per the detail.)
4. Details and schedules are shown as a means to aid the electrical contractor and are not meant to be all inclusive of all devices.
5. Assume responsibility for making takeoff of equipment required, (i.e., additional circuit breakers, motor connections, etc.) and ancillary equipment and appurtenances for a complete connection or circuit.
6. Verify all sizes of electrical equipment with shop drawings and nameplate rating of the equipment it serves.

L. Installation: Coordination Drawings

1. Prepare coordination drawings to a scale of ¼” = 1’0 or larger; detailing major elements, components, and systems of electrical equipment and materials in relationship with other systems, installations, and building components.
2. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the work, including, (but not limited to) the following:
3. Indicate the proposed locations of major raceway systems, equipment, and materials. Include the following:

a. Clearances for servicing equipment, including space for equipment disassembly required for periodic maintenance.
b. Exterior wall and foundation penetrations.
c. Fire-rated wall and floor penetrations.
d. Equipment connections and support details.
e. Sizes and location of required concrete pads and bases.

4. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
5. Locations include, but are not limited to, electrical rooms and other specialty electrical and communication rooms where equipment is being provided.

M. Installation: Bid Drawings

1. It must be understood that electrical drawings and details bid drawings are diagrammatic.
2. Electrical drawings and details bid drawings are not intended to be shop drawings.
3. It is expected that it may be necessary to move conduit, outlets and/or equipment in some cases to get coordinated installation and such changes are considered a part of the Contract obligation without cost to the Owner.
4. No outlets or equipment shall be located where the usefulness and/or operation will be affected by the work of other trades, door swing, counter, equipment, etc.

N. Installation: Contract Termination Requirements

1. Furnish Owner with service manuals for all items furnished under this Contract.
2. Service manuals shall be complete with drawings, diagrams, operations and installation instructions and parts lists.

3.5 OWNER TRAINING

A. Provide as outlined in each specification section requiring owner training.

3.6 SPARE EQUIPMENT

A. Provide as outlined per section 26 05 04.

END OF SECTION 260500

SECTION 260501 - PROJECT SPECIAL CONDITIONS

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. This specification covers those conditions that are particular to this project. This section further explains and outlines other portions of these specifications.

1.2 ADDITIONAL ITEMS

A. Include in bid the cost to provide the following additional items:

1. Ten duplex receptacles.
2. Five wall switches.
3. Three 20 amp, 3-phase motor connection.
4. Four fire alarm horn/strobe units.
5. Four fire alarm smoke detectors.
6. Four fire alarm pull stations.
7. Four exit lights.
8. Ten data outlets.

B. For each of the device mentioned above, assume a separate homerun circuit of a minimum of 150’. Include all conduit, wire, and labor. Assume a separate circuit breaker for each unit. For the motor assume a 208 volt circuit breaker.

1.3 SPARE EMPTY BOXES

A. Include in bid the cost to furnish and install ten blank box type outlets. This shall consist of:

1. A single gang box mounted 18" AFF.
2. 1" conduit extended from box up the ceiling and horizontally 30'.
3. Insulated connectors on each end.
4. Blank cover.

B. These boxes may be used for the Owner's provided sound system, communications, or security system. If these boxes are required, the contractor will be instructed as to where they are to be placed.

PART 2 - PRODUCTS

2.1 UTILITIES

A. Electrical Utilities

1. Alliant Energy

   Office: 800-255-4268
   2200 Campion Blvd.
   Prairie du Chien, WI 53821

2. Electric Service Utility costs shall be included in Electrical Contractor bid (see allowances).
3. Temporary Electric Service

   a. Installed by Electrical Contractor

4. Temporary Electrical Service Utility Fee

   a. By Electrical Contractor

5. Temporary Power Usage Cost

   a. By General Contractor

B. Fiber Utilities

1. Lumen/CenturyLink

   Office: 608-326-0931
   124 S. Beaumont Rd.
   Prairie du Chien, WI 53821

2. Fiber Service Utility costs shall be included in Electrical Contractor bid (see allowances).

C. CATV Utilities

1. Mediacom

   Office: 855-633-4226
   100 N. Marquette Rd.
   Prairie du Chien, WI 53821

2. CATV Service Utility costs shall be included in Electrical Contractor bid (see allowances).

2.2 ACCESS CONTROL, SECURITY CAMERA & AV SYSTEMS:

A. The owner is contracting the installation of access control, security camera, and audio-video cabling systems separately from this project.

B. Provide rough-in and 120-volt power required for locations shown on power plans. Rough-in to include boxes and conduit in walls and conduit for all cabling routed at exposed structure ceilings in all spaces. Also provide all sleeves thru floors and walls as required for cable routing.

C. Cabling, terminations, and equipment, etc. will be provided by owner's vendor separately from electrical construction.

D. Include time in bid to meet with owner's contractor and review their rough-in requirements.

1. Contact:
TC Networks
ATTN: David Bauer
Office: 877-897-6626
dbauer@tcnetworks.com

2.3 RADIO SYSTEM:

A. The owner is contracting the installation of radio system separately from this project.

B. Provide rough-in and 120-volt power required for locations shown on power plans. Rough-in to include boxes and conduit in walls and conduit for all cabling routed at exposed structure ceilings in all spaces. Also provide all sleeves thru floors and walls as required for cable routing.

C. Cabling, terminations, and equipment, etc. will be provided by owner's vendor separately from electrical construction.

D. Include time in bid to meet with owner's contractor and review their rough-in requirements.

1. Contact:
Baycom, Inc.
ATTN: Mike Bohan
Cell: 608-498-8887
mbohan@baycominc.com

2.4 CONCRETE BASES AND PADS

A. Provided per Division 26.

2.5 PRECAST CONCRETE PANELS

A. See architectural plans for locations of precast panels that will be solid-core. Ensure all work required to cast-in-place conduit and boxes are included in bid.

B. Where outlet boxes are shown on solid-core precast concrete, furnish all boxes and conduits required for devices shown on precast (other than at mechanical rooms, mezzanine spaces and data rooms) to Precast Panel Supplier at time of panel fabrication so that all conduit is concealed and all boxes are flush mounted. Provide all measurements required to locate such conduit and boxes within the manufacturer's requirements for fabrication.

2.6 CASE WORK/CONNECTIONS TO BUILT-IN-PLACE & FREE-STANDING COUNTERS/DESKS

A. For those areas indicated as having a built-in-place counter or desk, such as offices and IMCs, provide the electrical equipment shown within the desk. All equipment items shall be cut into the work side front of the desk. Cut in all devices.

B. Coordinate the actual device locations with the Owner or in a meeting with the Owner and with the counter/desk supplier. For counters mounted adjacent to the wall, provide junction boxes in the wall, and wire from these junction boxes into the counter. Provide EMT or flexible conduits through the counter hollow spaces to the various outlets shown.

C. On those plans where floor boxes are shown under the counter/desk, provide conduit-type box connections on these floor boxes and feed conduit up to the devices. In all cases, desks are shown as having power and a low-tension outlet. Rough-ins must be provided for each type of low-tension outlet, i.e. for telephone and data outlets in a counter, provide two separate conduit systems.

D. Provide all rough-in through the floor and all wiring hidden within the counter space to make connections to the equipment. Where low voltage-type outlets are shown, such as telephone, data, cable television, or empty boxes, provide a minimum 3/4" conduit stubbed from the box shown into the floor, up the nearest adjacent wall to the ceiling space where the conduit shall be terminated and marked as to its function, i.e. “kitchen island”.

2.7 SPRINKLER SYSTEM FLOW

A. Verify all requirements of the sprinkler flow system. Assume the following:

1. Furnish all wiring for interconnecting equipment.
2. Mount wall mounted control panel, interior bell, exterior bell.
3. Furnish connection from control panel to security panel, fire alarm panel and other monitoring panel if so indicated. If monitoring panels, other than the above two are indicated on the drawings.
4. Furnish and install exterior, weatherproof, wall mounted strobes. Provide weather resistant, engraved, brass nameplate mounted adjacent to strobe which states "Sprinkler Flow".

2.8 EQUIPMENT FURNISHED BY OWNER FOR DIVISION 26 INSTALLATION

A. Be responsible for installation of all equipment that is being furnished directly by the Owner. Include costs in bid to move the equipment from the owner’s storage to the project site, unpack the equipment, inspect the equipment for damage and call to the Owners attention any problems, dispose of packaging materials, and provide all connection and adjustment.

2.9 CASE WORK/FUME HOOD DIVISION 26 CONNECTIONS

A. Case work located in laboratories and art rooms, etc. where wiring devices are furnished as part of the equipment, but wired by Division 26, Division 26 to assume the following:

1. Furnished with Case Work:

    a. Opening in case work top or front for mounting of device.
    b. Face plates, outlet box for flush mounted type devices.
    c. Pedestal box receptacle and pipe nipple through top for pedestal mounted devices.

2. Furnished by Division 26:

    a. The rough-in stub-up through floor or walls for connections to device.
    b. Flexible conduit with ground wire from stub-up to a wiring device junction box.
    c. Mounting and attachment of wiring device.
    d. Installation of wiring device outlet box, pedestal into case work.
    e. Spare conduit as shown on details.
    f. Wiring devices.

2.10 OVERHEAD DOOR OPERATORS

A. The overhead door operators are furnished by other contractors. Division 26 is to provide the wiring to the door and the control. Work shall consist of the following:

1. Verify voltage and phase with door supplier prior to any rough-in.
2. Determine type of connection to overhead doors. Provide receptacle plug-in if applicable.
3. Provide disconnect at door operator.
4. Wire pushbutton operators. The electrical contractor shall assume that he is to provide conduit and wire from each of the pushbuttons to the door operator.
5. Wire door limit switches and pressure bar.

2.11 WIRING OF HANDICAP ACCESSIBLE MOTORIZED DOORS

A. The handicap door operators will be furnished by other contractors. Provide wiring to the door and to the control. Work will consist of the following:

1. Verify voltage and phase with door supplier prior to rough-in.
2. Determine type of connection to doors.
3. Provide rough-in, conduit and wiring for pushbutton operators.
4. Wire any limit switches or other controls associated with the door.
5. Electrical contractor shall review the specifications to determine exact requirements.

2.12 POWER VENT UNITS

A. Provide all electrical connections for power vent units. Whenever a clothes dryer is shown to be connected, this unit will have a power vent unit and should be wired to the nearest 120 volt circuit. Verify exact requirements with system supplier.

2.13 LOW VOLTAGE SYSTEM CABLE SLEEVES

A. Provide low voltage system cable sleeves throughout the building. Provide sleeves as follows:

1. All sleeves are to be steel and are to have insulated connectors on the end, or other type of cable protection.
2. Sleeves are to extend a minimum of 6” out from the wall.
3. A 1” sleeve shall be placed above the ceiling, through the wall, between all offices and corridors, and classrooms and corridors, or other areas where cables are to be routed. When there is more than one floor provide vertical (minimum 3-2") between floors.
4. In area where there is no finished ceiling, a conduit shall be extended from the communications outlet box, directly into an accessible ceiling area.
5. Cable shall be installed in conduit in all mechanical rooms, penthouses, gymnasiums, and any other open-structure rooms.
6. In addition to these sleeves, also provide the sleeves that are shown on the floor plans.
7. All low voltage devices in walls, including fire alarm devices, must have conduit stubbed from box in wall to above accessible ceiling.

2.14 UTILITIES COORDINATION

A. Be responsible for electric utility coordination on behalf of the owner. Contact the Owner to determine requirements, and from that, organize a meeting with the various system serving utilities such that the raceway stub-outs and installation of service can be done to coordinate with building construction.

2.15 MULTI-POLE CIRCUITS

A. Multi-pole circuits are not allowed for single-phase line to neutral loads.

PART 3 - EXECUTION

3.1 ALLOWANCES

A. For all equipment and labor allowances, assume the following:

1. All handling costs, profit margin, overhead, and taxes are assumed to be included in the contract, and thus the allowance cost is the actual contractor cost. If the allowance amount indicated is more than the actual cost, deduct this cost from the allowance amount, and the balance shall be deducted from the electrical contract by change order. In similar fashion, any costs above that shown on the allowance, shall be reimbursed to the contractor at his cost and will be added to the contract by change order.
2. For those items which require material and labor, the material and labor will be priced per the change order method listed in specification section 26 05 00.
3. The utility allowance is to cover cost assessed by the various utilities to provide permanent service to the facility. This service fee should cover the amount of the utility invoice only. It is not meant to cover:

    a. Temporary service fees (unless stated otherwise).
    b. Energy usage.
    c. Project electrical contractor materials or labor.

4. For those allowances for utility fees, the electrical contract will be adjusted up or down by change order by the amount listed for the change order, less the actual cost of the utility fee. No additional compensation for mark-ups or handling will be allowed by the contractor. Any such costs for this shall be included in the bid.

B. The following allowances shall be included in the contract:

1.	Electric utility fee	$30,000
2.	Fiber Utility Fee	$10,000
3.	CATV Utility Fee	$5,000

C. For all allowances listed, assume that all handling costs, taxes and installation are in addition to the allowance shown. The allowance amount shown is the invoice amount from the equipment supplier or subcontractor.

3.2 ALTERNATES (NONE)

END OF SECTION 260501

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SECTION 260504 - DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.2 SYSTEM PRE-INSTALLATION INFORMATION

A. Provide system pre-installation information for all equipment indicated on the Project Documentation Submittal List. Information shall include:

1. System wiring diagrams:

a. System wiring diagrams for the systems listed below shall be provided as a complete riser diagram. This riser diagram shall include all components of the system, as well as a designation adjacent to each component indicating the room or space in which it is located. Cable type used shall also be identified. This designation shall be by description of space or by room number.

1) Spec section 27 10 00 – Structured Cabling System.
2) Spec section 27 51 00 – Paging System.
3) Spec section 28 31 00 – Addressable Fire Alarm System

2. Diagram format:

a. All riser diagrams shall be done in the following manner:

1) CAD drawings.
2) All symbols used shall be the same symbols that are used on the electrical contract documents.

b. Each component of the built-up system must have the following information provided:

1) Each component must be indicated on a riser diagram and shown how it interconnects to other parts of the system.
2) Provide front elevation of rack or enclosure for system.
3) Size of enclosure shall be indicated.
4) Spacing or special mounting requirements shall be indicated.
5) Signal candela level.

B. System installation information shall be updated to reflect the installed system. This updated information shall be included as a part of the final O&M manual.

C. Drawings shall be supplied for each existing building system that is revised or added to. The drawings do not have to show all existing building equipment, only those items where the new system is extended from. A brief description should be given of the existing system and how it was extended.

D. Record drawings shall be reduced to 11" X 17" or 8 1/2" x 11" and included with the equipment drawings in the final O&M manual. See O&M MANUAL Description in this specification section.

1.3 FINAL TESTS AND DEMONSTRATIONS

A. Test all work and all equipment installed to ensure its proper and safe operation. Check all interlocking and automatic control sequences and test the operation of all safety and protective devices. Rectify all defects. Coordinate this work with the Power Company, supplier's representative and all other persons as directed by the OWNER or his representatives, in order to achieve the proper and intended operation of all equipment.

B. Test, adjust and record operating voltages at each system level before energizing branch circuits. Transformer taps must be adjusted to obtain as near as possible nominal system voltage. Where transformer is under Utility jurisdiction, obtain services of Utility to correct voltage. Be responsible for replacement of all devices and equipment damaged due to failure to comply with this requirement.

C. Balance load among feeder conductors at each panelboard and reconnect loads as may be necessary to obtain a reasonable balance of load on each phase. Electrical unbalance shall not exceed 10%.

D. Provide all instruments and equipment necessary to perform required tests.

E. All checks and tests shall be permanently recorded and made available to the OWNER or his representatives. The tests shall include:

1. System grounding
2. Fuses:

    a. Equipment nameplate requirement
    b. Actual fuse rating

3. Breakers:

    a. Nameplate
    b. Actual rating

4. Motors:

a. Complete nameplate data
b. Overload relay element
c. Voltage and current phase readings
d. Direction of rotation

5. Ampere readings on any cable operating in parallel to insure an even division of current.

F. The above reading shall be made for all fuses, breakers, motors and parallel cables installed as part of this contract and connected to by Division 26. This testing shall be for all new equipment, whether furnished by the electrical contractor or not.

G. Upon request, demonstrate proper operation of all electrical systems and equipment in the presence of the Architect's Consulting Electrical Engineer and/or other designated persons.

1.4 PROJECT CLOSEOUT CHECKLIST

A. Submit the following:

ITEM	**SUPPLIED TO:**	**CHECK OFF**
Accounting of all cash allowances as detailed in spec section 26 05 01. Submit invoices from utilities.	ARCHITECT	_____
Spare Fuses	OWNER	_____
Generator test report. (SPEC 26 32 00)	ARCHITECT	_____
Spare Fire Alarm Equipment (SPEC 28 31 00)	OWNER	_____
Fire Alarm Checklist (SPEC 28 31 00)	ARCHITECT	_____
Structured Wiring Documentation (SPEC 27 10 00)	ARCHITECT	_____
Structured Wiring Tabulations (SPEC 27 10 00)	ARCHITECT	_____
Structured Wiring Reduced Floorplans (SPEC 27 10 00)	ARCHITECT	_____
Structured Wiring Data Warranty (SPEC 27 10 00)	ARCHITECT	_____

Data Cable Installation Warranty (SPEC 27 10 00)	ARCHITECT	_____
Letter stating all specified spare equipment was delivered to owner. The letter should list the equipment supplied.	ARCHITECT	_____
O&M Manual	ARCHITECT	_____
Certificate from systems suppliers stating that the system was started up, tested and Owner's instructions were given. Certificate shall have date of instructions and test and shall have the owner's representative's signature.	ARCHITECT	_____
Copy of marked up record drawing.	ARCHITECT	_____
Provide warranty for all equipment	ARCHITECT	_____

END OF SECTION 260504

SECTION 260505 - THROUGH-PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

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

1.2 APPLICABLE PUBLICATIONS

A. Fire Test Requirements

1. ASTM E-814, “Fire Tests of Through Penetration Fire Stops”.
2. ANSI/ UL1479, “Fire Tests of Through Penetration Fire Stops”
3. ASTM E-119, “Fire Tests of Building Construction and Materials”.
4. ANSI/ UL263, “Fire Tests of Building Construction and Materials”.
5. ASTM E-84, “Surface Burning Characteristics of Building Materials”.
6. ANSI/ UL723, “Surface Burning Characteristics of Building Materials”.

B. References

1. Underwriters Laboratories (UL) of Northbrook, IL “Fire Resistance Directory”.

    a. Through Penetration Firestop Systems (XHEZ)
    b. Fill, Void or Cavity Materials (XHHW)
    c. Firestop Devices (XHJI)
    d. Forming Materials (XHKU)

2. All major building codes:

    a. Uniform Building Code published by ICBO
    b. Standard Building Code published by SBCCI.
    c. National Building Code published by BOCA.
    d. International Building Code published by ICC.

3. National Fire Protection Association (NFPA) of Quincy, MA “NFPA 101: Life Safety Code”.
4. National Fire Protection Association (NFPA) of Quincy, MA “NFPA 70: National Electrical Code”.

1.3 DESCRIPTION OF WORK

A. Furnish and install a complete firestopping installation as specified herein.

B. This section includes through-penetration firestop systems for electrical equipment and penetrations through the following fire-resistance rated assemblies, including both blank

openings and openings containing penetrating items such as conduits, cabling, cable trays and bus duct:

1. Floor-ceiling assemblies.
2. Roof-ceiling assemblies.
3. Walls and partitions.
4. Smoke barriers.
5. Construction enclosing compartmentalized areas.

1.4 RELATED WORK ELSEWHERE

A. Division 03 – Concrete

B. Division 04 – Masonry Work

C. Division 09 – Finishes

D. Division 13 – Special construction

E. Division 23 – Heating, Ventilation and Air Conditioning

F. Division 26, 27, and 28 – Electrical

1.5 SHOP DRAWINGS

A. Product Data: For each type of through-penetration firestop system product indicated.

B. System Drawings: Submit documentation from a qualified third-party testing agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.

C. Product Certificates: Certificate of conformance signed by manufacturers of through-penetration firestop system products certifying that products comply with requirements.

1.6 OPERATION & MAINTENANCE MANUALS (NONE)

1.7 QUALITY ASSURANCE

A. Provide through-penetration firestop systems that comply with the following requirements :

1. Firestopping tests are performed by a qualified, testing and inspection agency. A qualified testing and inspection agency is UL, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
2. Through-penetration firestop system products bear classification marking of qualified testing and inspection agency.
3. Engage an experienced installer who is certified, licensed or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install

firestop products per specified requirements. A manufacturer's willingness to sell its through-penetration firestop system products to Contractor or to an installer engaged by Contractor does not in itself confer qualifications on buyer.

B. Obtain through-penetration firestop systems for each type of penetration and construction condition indicated from a single manufacturer.

C. Through-penetration firestop systems shall be subjected to necessary inspections and tests.

D. Keep areas of work accessible until inspection by authorities having jurisdiction.

E. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

1.8 WARRANTY

A. Equipment shall be warranted for a period of not less than 1 year from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

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.

PART 2 - PRODUCTS

2.1 FIRESTOPPING, GENERAL

A. Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Provide components for each through-penetration firestop system that are needed to install fill materials. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

C. Performance Requirements

1. Provide products that upon curing do not re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during and after construction.
2. Openings within walls and floors designed to accommodate cabling systems subjected to frequent cable changes shall be provided with re-enterable products specifically designed for retrofit.

2.2 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with through-penetration firestop systems (XHEZ) listed in Volume 2 of the UL Fire Resistance Directory, provide products of the following manufacturers as identified below:

1. Manufacturers listed in the UL Fire Resistance Directory – Volume 2.

2.3 MATERIALS

A. General: Use only through-penetration firestop system products that have been tested for specific fire-resistance-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.

B. Latex Sealants: Single component latex formulations that upon cure do not re-emulsify during exposure to moisture.

C. Firestop Devices: Factory-assembled steel collars lined with intumescent material sized to fit specific outside diameter of penetrating item.

D. Firestop Putty: Intumescent, non-hardening, water resistant putties containing no solvents, inorganic fibers or silicone compounds.

E. Firestop Putty Pads: Intumescent, non-hardening putty pads to be installed on metallic and nonmetallic electrical switch and receptacle boxes to reduce horizontal separation between boxes to less than 24”.

F. Wrap Strips: Single component intumescent elastomeric strips faced on both sides with a plastic film.

G. Firestop Pillows: Re-enterable, non-curing, mineral fiber core encapsulated with an intumescent coating contained in a flame retardant poly bag.

H. Mortar: Portland cement based dry-mix product formulated for mixing with water at Project site to form a non-shrinking, water-resistant, homogenous mortar.

I. Silicone Sealants: Moisture curing, single component, silicone elastomeric sealant for horizontal surfaces (pourable or nonsag) or vertical surface (nonsag).

J. Silicone Foam: Multicomponent, silicone-based liquid elastomers, that when mixed, expand and cure in place to produce a flexible, non-shrinking foam.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.

B. Do not proceed until unsatisfactory conditions have been corrected.

3.2 FIELD MEASUREMENTS

A. Verify that field measurements are as shown on Drawings.

3.3 DELIVERY STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Accept equipment on site. Inspect for damage.

C. Protect equipment from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

D. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturer's labels identifying product and manufacturer, date of manufacture; lot number; shelf life, if applicable; qualified testing and inspection agency's classification marking; and mixing instructions for multicomponent materials.

E. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants or other causes.

3.4 INSTALLATION

A. General Requirements: Install through-penetration firestop systems in accordance with "Performance Criteria" Article and in accordance with the conditions of testing and classification as specified in the published design.

B. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration firestop systems products.

1. Seal all openings or voids made by penetrations to ensure an air and water resistant seal.
2. Protect materials from damage on surfaces subjected to traffic.

C. Remove equipment, materials and debris, leaving area in undamaged, clean condition.

D. Clean all surfaces adjacent to sealed openings to be free of excess through-penetration firestop system materials and soiling as work progresses.

E. Project conditions

1. Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limitations recommended by manufacturer.
2. Do not install through-penetration firestop systems when substrates are wet due to rain, frost, condensation, or other causes.
3. Do not use materials that contain flammable solvents.

4. Do not install water-based or products that are conductive when wet in contact with energized electrical conductors. Exercise care when energizing penetrants.

F. Coordination

1. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
2. Coordinate sizing of sleeves, openings, core-drilled holes or cut openings to accommodate through-penetration firestop systems.
3. Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.

G. Preparation

1. Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellents, and any other substances that may inhibit optimum adhesion.
2. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
3. Do not proceed until unsatisfactory conditions have been corrected.

3.5 OWNER TRAINING (NONE)

3.6 SPARE EQUIPMENT (NONE)

END OF SECTION 260505

SECTION 260519 - WIRE AND CABLE

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.2 APPLICABLE PUBLICATIONS

A. American National Standards Institute/National Fire Protection Agency (ANSI/NFPA), Specifications and Standards, current edition:

1. NFPA 70 – National Electrical Code.
2. ANSI/TIA/EIA-568-B.2.

B. National Electrical Contractors Association (NECA), Standard of Installation, current edition.

C. National Electrical Manufacturers Association (NEMA), Specifications and Standards, current edition.

D. Underwriters Laboratories, Inc. (UL).

1.3 DESCRIPTION OF WORK

A. Furnish and install a complete and operable wire and cable system as indicated on the drawings and as specified herein.

1.4 RELATED WORK ELSEWHERE

A. Division 11: Equipment

B. Division 23: Heating, Ventilation and Air Conditioning

C. Division 26, 27, and 28: Electrical

1.5 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

1.6 OPERATION & MAINTENANCE MANUALS

A. Submit Operations & Maintenance Manuals in accordance with Section 26 05 04.

B. The following information shall be submitted in addition to the items listed above:

1. Manufacturer literature in scope to demonstrate compliance with the requirements of this specification.
2. Clearly identify the types of wire and cable proposed.

1.7 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. Wire and cable manufacturers shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development and production in accordance with ISO 9001.

C. All materials, equipment, and parts shall be new and unused of current manufacture.

D. Provide all necessary accessories required for a complete and operable system.

1.8 WARRANTY

A. Wire and cable shall be warranted for a period of not less than 1 year from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

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.

PART 2 - PRODUCTS

2.1 GENERAL

A. Approved manufacturer:

1. Contractor’s option.

B. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials and equipment shall be new (less than 1 year old when turned over to the Owner).

2.2 WIRE AND CABLE – GENERAL PURPOSE (600V)

A. General:

1. All conductors with ampacity of 100A or less shall be copper. Aluminum conductors are allowed for feeders with ampacity greater than 100A with exception of conductors feeding chiller, motors, and generators. Feeders for this equipment must be copper.
2. THWN or THHN general purpose building wire insulated with polyvinyl chloride (PVC) and covered with protective sheath of nylon intended for lighting and power circuits at 600 volts or less, in residential, commercial, and industrial buildings.
3. The wire shall be suitable for 90ºC maximum continuous conductor temperature in dry locations and 75ºC in wet locations and listed by Underwriters Laboratories for use in accordance with Article 310 of the National Electrical Code.

B. Conductors:

1. Class B or Class C stranded, annealed uncoated copper per UL Standard 83 or 1063.
2. Where aluminum conductors are allowed, aluminum alloy conductors shall be compact stranded conductors of a recognized Aluminum Association 8000 Series aluminum alloy conductor material (AA-8000 series alloy).

C. Insulation:

1. Each conductor shall be insulated with PVC and sheathed with nylon complying with the requirements of UL Standard 83 for Types THHN or THWN and UL Standard 1063 for Type MTW and CSA C22.2 No. 75 for T90 Nylon.
2. Types THWN or THHN shall comply with the optional Gasoline and Oil Resistance rating of UL Standard 83. The insulation shall also comply with UL requirements for 105ºC Appliance Wiring Material.
3. The average thickness of PVC insulation, for a given conductor size, shall be as specified in UL Standard 83 for TWHN or THHN. The minimum thickness at any point, of the PVC insulation, shall be not less than 90 percent of the specified average thickness.
4. The minimum thickness at any point of the nylon sheath shall be as specified in UL Standard 83 for Types THWN or THHN.
5. Where aluminum feeders are allowed, insulation to meet requirements of XHHW-2 Standards.
6. The PVC insulation shall be applied tightly to the conductor and shall be free-stripping.

D. Identification:

1. The wire shall be identified by surface marking indicating manufacturer’s identification, conductor size and metal, voltage rating, UL Symbol, type designations, and optional ratings. The wire shall also be identified as C (UL) Type T90 Nylon or TWN 75, FT1.

E. Tests:

1. Wire shall be tested in accordance with the requirements of UL Standard 83 for Types THWN or THHN wire and for the optional Gasoline and Oil Resistance listing; as Type MTW to UL Standard 1063 (stranded items): as AWM to UL Standard 758 (stranded items); and as C(UL) Type T90 Nylon or TWN75.

F. Usage:

1. General use power wiring, minimum size No. 12 AWG.
2. General use control wiring, minimum size No. 14 AWG.

2.3 WIRE AND CABLE – UNDERGROUND (600V)

A. General:

1. USE-2 or RHH, cross linked polyethylene insulated cables for use in circuits not exceeding 600 volts. Cables listed by UL as Type USE-2 and recognized for underground use in wet locations at a maximum continuous conductor temperature of 90ºC in accordance with Article 338 of the National Electric Code.
2. UL listed as Type RHH or RHW-2 for general purpose wiring applications at maximum continuous conductor temperature of 90ºC in dry locations (RHH) or 90ºC in wet or dry locations (RHW-2).
3. Installed in air, conduit, or other recognized raceways in accordance with Article 310 of the National Electric Code.

B. Conductors:

1. Conductors shall be Class B stranded annealed uncoated copper per UL Standard 854 and 44.
2. A suitable separator over the conductor may be used at the option of the manufacturer.

C. Insulation:

1. Each conductor shall be insulated by surface marking indicating manufacturer's identification, conductor size and metal, voltage rating, UL Symbol, and type designations.

D. Tests:

1. Wire shall be tested in accordance with the requirements of UL Standard 8654 for Type USE-2, UL Standard 44 for Types RHW-2 or RHH.

E. Usage:

1. Underground power wiring, minimum size No. 12 AWG.

2.4 PORTABLE CORD GENERAL USE

A. All portable general use cords shall be SO type.

2.5 WIRING CONNECTORS

A. Polaris Type Mechanical Connectors:

1. 8 AWG and larger wire for all motor connections.

B. Spring Wire Connectors:

1. 10 AWG and smaller wire.

C. Compression Connectors (T&B Sta-Kon or equal):

1. Fire alarm wiring.
2. Control wiring.
3. For those devices that are not rated to accept stranded wire.

D. Cord Connectors. All cord connectors should be Kellums type using wire mesh cord restraint.

E. Provide watertight Crouse-Hinds or equal cord grips in appropriate areas.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that wire is in compliance with specifications.

B. Verify that interior of building has been protected from weather.

C. Verify that mechanical work likely to damage wire and cable has been completed.

D. Inspect wire for physical damage and proper connection.

E. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.

F. Verify continuity of each conductor.

G. Feeder or branch circuits with ampacity greater than 100 amperes shall be tested after installation to measure insulation resistance of each conductor.

1. All equipment shall be disconnected and the wire ends shall be cleaned and dried.
2. Connect Megohmeter between conductor and a grounded point in the enclosure and energize until the reading stabilizes.
3. The Megohmeter reading for each conductor shall not be less than 10,000 Megohoms.

3.2 FIELD MEASUREMENTS

A. Field verify all measurements. Do not base on contract drawings.

B. Identify conflicts with the work of other trades prior to installation of work.

C. Adjust system to satisfy field requirements.

3.3 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Maintain original quality and condition of wire while it is in storage.

3.4 INSTALLATION

A. General:

1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer's recommendations.
2. Install all materials, assemblies and equipment in strict accordance with manufacturer's recommendations and instructions. Consult manufacturer for all wiring diagrams, schematics, sizes, outlets, etc. before installing.

B. Pre-Installation:

1. Verify that interior of building has been protected from weather.
2. Verify that mechanical work likely to damage wire has been completed.
3. Completely and thoroughly swab raceway prior to installation.
4. Verify that field measurements are as shown on drawings.
5. Wire and cable routing shown on drawings is approximate unless dimensioned. Route wire and cable to satisfy project conditions.
6. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.
7. Determine required separation between cable and other work.
8. Determine cable routing to avoid interference with other work.

C. Conductor Sizing:

1. Conductor sizes are based on copper.
2. Use conductor not smaller than No.12 AWG for power and lighting circuits.
3. Use No.10 AWG conductors for 20 ampere, 120-volt branch circuits longer than 75 feet.
4. Use No. 10 AWG conductors for 20 ampere, 277-volt branch circuits longer than 200 feet.
5. Where circuit wiring length exceeds 100 feet, increase wire size as needed to maintain a maximum voltage drop of three percent.
6. Use conductor not smaller than No.14 AWG for control circuits.
7. Wire and cable size shall be increased from size indicated or required by code to meet the following voltage drop requirements:

    a. 3% drop for branch circuits.
    b. 5% drop for motor circuits.

D. Wire Pulling:

1. Pull all conductors into raceway at same time.
2. No.4 AWG and larger wire and power cables shall be lubricated with pulling lubricant to reduce pulling tension and abrasion damage. The lubricant shall be water or wax based containing no oils or greases that may adversely affect cable jackets. Follow cable manufacturer's specifications regarding use of lubricant.
3. The minimum bend radius and maximum pulling tension ratings of the wire and cable shall not be exceeded.

E. Splices and Terminations:

1. Splices and terminations shall not be made within raceways.
2. Clean conductor surfaces before splicing or terminating.
3. Make splices, taps, and terminations to carry full amp capacity of conductors with no perceptible temperature rise.
4. Wire nuts, “ScotchLocks”, and similar devices may be used to splice 120V power circuits.
5. Control, communication, and data transmission wire and cable shall not be spliced.
6. Support cables above accessible ceiling, using spring metal clips or plastic cable ties to support cables from structure. Do not rest cable on ceiling panels or support for the ceiling suspension system per NEC.
7. Neatly train and lace wiring inside boxes, equipment, and panelboards.
8. Clean conductor surfaces before installing lugs and connectors.
9. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
10. All aluminum conductors shall terminate on tin plated, aluminum-bodied compressor lug or compression adapter. An oxide-inhibiting joint compound must be applied on the aluminum conductor during termination. The compression connectors shall be installed according to manufacturers’ instructions with the compression tool recommended by the manufacturer of the connector.
11. Perform an infrared survey of all aluminum conductor connections after the installation is complete and in normal service. Infrared surveys shall be performed during periods of maximum possible loading with at least 30% of rated load of the equipment being inspected. All connections with elevated temperatures shall be corrected by the contractor.
12. Use polaris type mechanical connectors for copper conductor splices and taps, 8 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.
13. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

F. Motors:

1. Motor wiring to motors less than 10 horsepower shall be spliced and terminated with fully insulated crimp-on end cap with a layer of self-vulcanizing rubber tape, followed by five layers of vinyl electrical tape. “SkotchLocks” and similar devices shall not be used.
2. Motor wiring to motors 10 horsepower or larger shall be spliced and terminated with crimp-on ring terminal lugs, brass nuts, bolts and washers with a layer of self-vulcanizing rubber tape, followed by five layers of vinyl electrical tape. “SkotchLocks” and similar devices shall not be used.

G. Wire Marking:

1. The ends of each conductor shall be marked with circuit number, motor number, wire or terminal number.
2. Labels shall be typed in black lettering with indelible ribbons on a white, heat shrink sleeve. Markers shall be shrunk around the wire to provide a tight, non-slip bond with a compatible heat gun.
3. Heat shrink wire markers shall be Brady Bradysleeve Type B-321 or B-322

H. Color Coding:

1. Color coding shall be as follows:

	120/208V System
Phase A	Black
Phase B	Red
Phase C	Blue
Neutral	White
Ground	Green

I. Ground Wire Color Coding

1. Provide green insulated ground wire for #8 and smaller. #6 wire shall have green band per code.

J. Control Panels:

1. Control panel wiring. Wiring within control cabinets shall be stranded type MTW.

3.5 OWNER TRAINING (NONE)

3.6 SPARE EQUIPMENT (NONE)

END OF SECTION 260519

SECTION 260526 - GROUNDING

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.2 APPLICABLE PUBLICATIONS

A. Conform to requirements of current ANSI/NFPA 70 - National Electric Code.

B. Conform to current Underwriters Laboratories (UL) Specifications and Standards.

C. Conform to current Telecommunication Industry Association (TIA/EIA).

D. Conform to National Electrical Contractors Association (NECA) “Standards of Installation”.

E. Product specific standards and requirements are included in product specifications.

F. EIA/TIA-607.

1.3 DESCRIPTION OF WORK

A. Furnish and install a complete and operable grounding and bonding system as indicated on drawings and specified herein.

B. Ground and bond all equipment required per all applicable codes whether or not specifically shown on drawings.

C. Bond together system neutrals, service equipment enclosures, exposed non current carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and plumbing systems.

D. Provide grounding from main electric service to telecommunications ground bus per drawing details. Bond to all metal enclosures and racks. Bond all cable trays and conduit stubs.

1.4 RELATED WORK ELSEWHERE

A. Division 26, 27, and 28: Electrical

1.5 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

B. The following information shall be submitted in addition to items listed above:

1. Complete riser diagram indicating copper backbone from main service ground to telecommunications ground bus.

1.6 OPERATION & MAINTENANCE MANUALS (NONE)

1.7 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. The following shall be submitted in addition to those items listed above:

1. Measure ground resistance from system neutral connection at service entrance to convenient ground reference point using suitable ground testing equipment. Resistance shall not exceed 2 ohms. Additional grounding electrodes shall be used to satisfy ground resistance requirements where required by earth conditions.
2. Measure ground resistance from each telecommunications bus bar to convenient ground reference point using suitable ground test equipment. Resistance shall not exceed 1 ohm. Ground must be installed per drawing details.

1.8 WARRANTY

A. 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.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

C. Submit a written warranty executed by the installer indicating ground test was completed.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials and equipment shall be new (less than 1 year old when turned over to the Owner).

B. Provide a complete and fully functional grounding system using materials and equipment of types, sizes, and rating as required to meet performance requirements. Use materials and equipment that comply with referenced standards and manufacturer's standard design and construction, in accordance with published product information. Coordinate the features of all materials and equipment so they form an integrated system, with components and interconnections matched for optimum performance of specified functions. Provide all accessories necessary for a fully functioning system.

2.2 GROUND RODS

A. Material: Copper-clad steel.

B. Diameter: 3/4" minimum.

C. Length: 10’ minimum. Rod shall be driven at least 9’5”deep.

D. Use one or more ground rods to obtain the minimum specified ground resistance. This applies to manholes, padmount switches, transformers, service entrances, and all other equipment requiring a supplemental grounding electrode. Minimum of three ground rods shall be used to ground the service entrance as indicated on plans.

2.3 MECHANICAL CONNECTORS

A. The mechanical connector bodies shall be manufactured from high strength, high conductivity cast copper alloy material. Bolts, nuts, washers, and lockwashers shall be made of silicon bronze and supplied as a part of the connector body and shall be of the two bolt type.

B. Split bolt connector types are not allowed.

C. The connectors shall meet or exceed UL 467 and be clearly marked with the catalog number, conductor size and manufacturer.

2.4 COMPRESSION CONNECTORS

A. The compression connectors shall be manufactured from pure wrought copper. The conductivity of this material shall be no less than 99 percent.

B. The connectors shall meet or exceed the performance requirements of IEEE 837, latest revision.

C. The installation of the connectors shall be made with a compression, tool and die system, as recommended by the manufacturer of the connectors.

D. The connectors shall be clearly marked with the manufacturer, catalog number, conductor size, and the required compression tool settings.

E. Each connector shall be factory filled with an oxide-inhibiting compound.

2.5 EXOTHERMIC CONNECTIONS

A. Select the appropriate kit for specific types, sizes, and combinations of conductors and other items to be connected. Field personnel shall be trained in execution of welds.

2.6 WIRE

A. Material: Stranded copper (aluminum permitted only with aluminum conductors).

B. Grounding Electrode Conductor: Size as shown on drawings, specifications, or required by NFPA 70, whichever is larger.

C. Feeder and Branch Circuit Equipment Ground: Size as shown on drawings, in specifications, or as required by NFPA 70, whichever is larger. Differentiate between the normal ground and the isolated ground when both are used on the same facility.

2.7 TELECOMMUNICATIONS GROUND BUS BAR

A. Telecommunication Main Grounding Busbar (TMGB)

1. Provide a pre-manufactured ground bus attached to the wall or rack enclosure per drawings.
2. Bus shall be equipped with six connection points for #10 or smaller wire, using set screws to capture the wire. This is in addition to the termination points for the grounding backbone and the jumpers to the telecommunications system.
3. See details for equipment.

B. Telecommunication Grounding Busbar (TGB)

1. Provide a pre-manufactured ground bus attached to the wall or rack enclosure per drawings.
2. Bus shall be equipped with six connection points for #10 or smaller wire, using set screws to capture the wire. This is in addition to the termination points for the grounding backbone and the jumpers to the telecommunications system.
3. See details for equipment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

B. Verify proper labeling is provided on all telecommunications bus bars.

3.2 FIELD MEASUREMENTS

A. Field verify exact routing of all backbone cable.

B. Adjust grounding system installation to satisfy field requirements.

3.3 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

3.4 INSTALLATION

A. General:

1. Provide a separate, insulated equipment grounding conductor in all raceways.
2. Connect grounding electrode conductors to metal water pipe:

    a. Use a suitable ground clamp.
    b. Make connections to flanged piping at street side of flange.
    c. Provide bonding jumper around water meter.

3. Supplementary Grounding Electrode:

    a. Use driven ground rod on exterior of building.
    b. Install ground rod in suitable recessed well; fill with gravel after connection is made.
    c. Effectively ground metal frame of the building.
    d. Install grounding conductor to footing rebar per NEC.

4. Provide ground wire in all surface metal raceways, wireways, in floor duct and in wall duct.
5. Receptacle grounding:

    a. For all receptacle circuits, provide separate green ground wire in raceway system.
    b. Receptacles shall be isolated ground type where called for specifically on the drawing in other areas.
    c. Standard receptacles may be used and green wire shall be directly connected to receptacle or to pigtail.
    d. Provide #12 pigtail to ground all metal boxes.
    e. Stranded wire twisted on ground terminal on device is not allowed.

B. Telecommunication Ground Points

1. Telecommunications main grounding bus bar (TMGB).

    a. Adjacent to each TMGB, provide warning label with the following wording:

"WARNING"
If this conductor or cable is
loose or must be removed
please call the building
telecommunications manager.

    b. Install per riser diagram detail.
    c. Provide a pre-manufactured ground bus attached to the enclosure wall.
    d. Terminate ground wire on bus.
    e. Bond bus to enclosures and cable tray.

2. Telecommunications grounding bus bar (TGB)

    a. Adjacent to each TGB, provide warning label with the following wording:

"WARNING"
If this conductor or cable is
loose or must be removed,
please call the building
telecommunications manager.

b. Install per riser diagram detail.
c. Provide a pre-manufactured ground bus attached to the enclosure wall.
d. Terminate ground wire on bus.
e. Bond bus to enclosures and cable tray.

C. Ground Rod Installation

1. Install ground rods to be 10’6” deep.

3.5 OWNER TRAINING (NONE)

3.6 SPARE EQUIPMENT (NONE)

END OF SECTION 260526

SECTION 260529 - SUPPORTING DEVICES

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.2 APPLICABLE PUBLICATIONS

A. Conform to requirements of current ANSI/NFPA 70 - National Electric Code.

B. Conform to current American National Standards Institute (ANSI) standards.

C. Conform to current American National Standards Institute ANSI B31.1 standards.

D. Conform to National Electrical Contractors Association (NECA) “Standards of Installation”

1.3 DESCRIPTION OF WORK

A. Furnish and install complete and operable support devices as required.

B. Metal supporting devices shall be zinc galvanized or cadmium plated steel or malleable iron.

C. Equipment and materials shall be supported with devices designed for such purpose. Wire or plastic ty-raps not acceptable.

D. Where so specified on the drawings, provide stainless steel, PVC covered, or hot dipped galvanized.

E. Refer to drawings or other portions of the specifications for particular pieces of equipment which may require more stringent equipment specifications than listed in this specification.

1.4 RELATED WORK ELSEWHERE

A. Division 03: Concrete

B. Division 04: Masonry

C. Division 07: Thermal and Moisture Protection

D. Division 23: Heating, Ventilation and Air Conditioning

E. Division 26, 27, and 28: Electrical

1.5 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

1.6 OPERATION & MAINTENANCE MANUALS (NONE)

1.7 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. All materials, equipment and parts are to be new, undamaged and unused of current Manufacture.

1.8 WARRANTY

A. Equipment shall be warranted for a period of not less than 1 year from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

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.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials and equipment shall be new (less than 1 year old when turned over to the Owner).

2.2 LIGHTING FIXTURE SUPPORT

A. Provide items such as stems, hickeys, bar hangers, and clips required to securely attach fixtures to ceilings or walls.

B. Provide troffer arms for supports, lay-in troffers for exposed grid ceiling and grid troffer support clips in accordance with NEC and manufacturer’s recommendations.

C. Provide and install channel supports across main grid runners or grid supports, securely tied down or anchored for fixtures and devices mounted in suspended ceiling systems not causing tile to sag and so fixture or device cannot be lifted, rotated or displaced.

D. Provide spacers or stabilizers to eliminate fixture instability.

E. Drilled expansion insert type anchors suitable for load and application requirements such as sleeve anchors, lag shields, and plastic anchors.

F. Provide auxiliary supports so fixtures can be drawn up tightly, tilted or rotated, and not affected by vibrations.

2.3 SUPPORTING STRUCTURES

A. Rack supports of galvanized steel channel sections with adequate feet to allow secure mounting. Weld sections, do not use bolts.

2.4 MOUNTING EQUIPMENT

A. For all panelboard, starters, disconnects, VFDs, control panel, etc. provide mounting panels of not less than 1/4 in. steel plate or 3/4 in. exterior grade plywood. Provide uniform mounting panels as far as practical. Paint plywood panels with 2 coats of fire rated gray enamel paint on all sides and ends.

2.5 CONDUIT SUPPORTS

A. 1- hole galvanized steel straps for EMT, 2-hole galvanized steel straps for all other conduits. Do not use perforated hanger iron.

2.6 VERTICAL CABLE SUPPORT

A. Support conductors in vertical raceways using suitable cable supports. Locate supports so each 25 ft-0 in. length of conductor in vertical raceway will be complete with support.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify locations prior to rough in.

B. Verify mounting details

3.2 FIELD MEASUREMENTS

A. Verify that field measurements are as shown on Drawings.

3.3 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Accept equipment on site. Inspect for damage.

C. Protect equipment from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

3.4 INSTALLATION

A. General:

1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer's recommendations.
2. Install all materials, assemblies and equipment in strict accordance with manufacturer's recommendations and instructions. Consult manufacturer for all wiring diagrams, schematics, sizes, outlets, etc. before installing.

B. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation".

C. Do not fasten supports to pipes, ducts, mechanical equipment, or other conduit.

D. Do not use spring steel clips on ceiling support wires.

E. Do not use powder actuated anchors.

F. Obtain permission from Architect before drilling or cutting structural members.

G. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present a neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

H. Install surface mounted cabinets and panelboards with minimum of four anchors.

I. In wet and damp locations use steel channel supports to stand cabinets and panelboards one inch off wall.

J. Use steel metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

K. Degrease and clean surfaces to receive nameplates and labels.

L. Install nameplate and label parallel to equipment lines.

M. Secure nameplates to equipment fronts using screws if so specified on drawings.

N. Anchors:

1. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31 and transfer of loading and stresses to connected equipment.
2. Installation methods shall be in conformity with manufacturer's recommendations for maximum holding power.

O. Conduit Supports

1. Support conduit as follows:

    a. Vertical Surfaces: Galvanized, heavy-duty, sheet steel straps; back straps provided for exposed conduit and conduit on exterior walls.
    b. Horizontal Surfaces: Single or double rack channel trapeze, complete with conduit straps as required; supported with threaded hanger rods.

2. Support 1 3/4 in. and larger conduit runs passing through floors at each floor with riser pipe clamps.

P. Conduit Extending Through Roof:

1. Conduit extending through roof shall pass through ceiling box at roof line.
2. Provide 14 ga minimum galvanized 12 gauge box complete with watertight soldered seams and flanged to serve as pitch pocket for each conduit or provide a neoprene boot as compatible with roof.
3. Install conduit and pitch pocket in advance of roofing work.
4. Coordinate with roofer for providing all appurtenances required so that the installed system complies with roofing installation.

3.5 OWNER TRAINING (NONE)

3.6 SPARE EQUIPMENT (NONE)

END OF SECTION 260529

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SECTION 260534 - RACEWAYS

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.2 APPLICABLE PUBLICATIONS

A. Conform to requirements of current ANSI/NFPA 70 - National Electric Code.

B. Conform to current National Electrical Manufactures Association (NEMA) Standards.

C. Conform to current Underwriters Laboratories (UL) Specifications and Standards.

D. Conform to current Telecommunication Industry Association (TIA/EIA).

E. Conform to current American National Standards Institute (ANSI) standards.

F. Conform to National Electrical Contractors Association (NECA) “Standards of Installation”.

G. Product specific standards and requirements are included in Product Specifications.

1.3 DESCRIPTION OF WORK

A. Furnish and install a complete and operable conduit/raceway system as indicated on the drawings and as specified herein.

B. All wire shall be in conduit. All conduits for branch circuit wiring (light switches, receptacles, etc.), structured (data) cabling system, station alerting system, and security systems (camera and keyless entry) at walls, including in Apparatus Bays, Mezzanines, etc. shall be concealed.

C. Where conduit passes through areas of differing temperatures, such as into or out of cool-rooms, freezers, unheated and heated spaces, buildings, provide listed conduit seals to prevent the passage of moisture and water vapor through the conduit.

D. Materials Included:

1. Metal conduit.
2. Flexible metal conduit.
3. Liquidtight flexible metal conduit.
4. Electrical metallic tubing.
5. Nonmetallic conduit.
6. Wireways.
7. PVC covered rigid steel conduit.

8. MC cable.

1.4 RELATED WORK ELSEWHERE

A. Division 03: Concrete

B. Division 04: Masonry

C. Division 09: Finishes

D. Division 12: Furnishing

E. Division 23: Heating, Ventilation and Air Conditioning

F. Division 26, 27, and 28: Electrical

1.5 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

1.6 OPERATION & MAINTENANCE MANUALS

A. Submit Operations & Maintenance Manuals in accordance with Section 26 05 04.

1.7 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. All materials, equipment and parts are to be new, undamaged and unused of current manufacture.

1.8 WARRANTY

A. Equipment shall be warranted for a period of not less than 1 year from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

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.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials and equipment shall be new (less than 1 year old when turned over to the Owner).

2.2 CONDUIT GENERAL REQUIREMENTS

A. Minimum Size: 1/2 inch.

B. Conduit types not listed below are prohibited.

C. Rigid heavy wall galvanized steel conduits:

1. Are to be used in the following locations:

a. Outdoors.
b. Underground, unless PVC is shown on drawings or called out in other portions of this specification.
c. In and under ALL concrete slabs, except for where PVC is allowed as stated in nonmetallic conduit portion of this specification.
d. In sizes 2-1/2" and larger, where the conduit is exposed and where it is installed between the floor and 8' AFF. Above this height EMT conduit may be used.
e. In areas having moisture, dust or gases.
f. Exposed conditions where such mechanical protection is required.

2. Manufacturer: CONTRACTOR option.
3. Conduit:

a. Impact and crush resistant mild steel tube with an accurate circular cross section, a uniform wall thickness, a defect free interior surface, and a continuous welded seam.
b. Interior and exterior surfaces thoroughly and evenly coated with zinc using the hot-dip galvanizing process.
c. Top-coated with a compatible organic layer to inhibit white rust and increase corrosion resistance.
d. Factory cut threads, 0.75-inch taper per foot, protected after cutting with an application of molten zinc.

4. Conduit Bodies:

a. Ferrous metal construction electro-galvanized inside and out and coated with aluminum acrylic paint.
b. Tapered, threaded hubs with integral bushing.
c. Stainless steel hardware.
d. Cover constructed of same material with solid gasket.

5. Fittings:

    a. Ferrous metal construction electro-galvanized inside and out.
    b. Components critical to performance such as set screws, split rings, and locknuts constructed of hardened steel or adequately designed to insure positive bonds.

D. IMC (Intermediate Metal Conduit) is applicable in place of rigid heavy wall galvanized steel conduit in the following locations:

1. All areas except primary raceways.

E. Thinwall conduit:

1. May be used in the following locations:

    a. Indoors in dry locations (walls, ceilings, exposed).
    b. In sizes 2 1/2" and larger, where installed above ceilings or installed more than 8' above the floor. See paragraph B - Rigid heavy wall conduit.

2. Manufacturer: CONTRACTOR option.
3. Conduit:

    a. Mild steel tube with an accurate circular cross section, a uniform wall thickness, a defect free interior surface, and a c1ontinuous welded seam.
    b. Interior and exterior surfaces thoroughly and evenly coated with zinc using the hot-dip galvanizing process.

4. Fittings:

    a. Setscrew, steel construction electro-galvanized inside and out.
    b. Insulated throat connectors.
    c. Components critical to performance such as set screws, split rings, and locknuts constructed of hardened steel or adequately designed to insure positive bonds.

F. Flexible Conduit:

1. Lengths limited to minimum necessary, 6' maximum.
2. Limit use to dry areas.
3. For connection of lighting fixtures, motors and similar equipment.
4. To contain an equipment grounding conductor with phase conductors.
5. Bond grounding conductor to equipment served and nearest conduit system junction box.
6. Manufacturer: CONTRACTOR option.
7. Usage:

    a. Use only in conjunction with electrical metallic tubing

8. Conduit:

    a. Single strip, helically wound, galvanized steel with smooth interior surface conforming to applicable UL Standards.

b. Minimum size 1/2-inch may be used in lengths not to exceed 3-feet. All runs of flexible conduit shall be as short as practicable, of the same size as the conduit it extends and with enough slack to reduce the effects of expansion and vibration.

9. Fittings:

a. Connectors shall be malleable iron or steel with insulated throat, squeeze-type, with annular gripping rib. Particular attention shall be given to maintaining ground bond and firm support through flexible connections. Connections shall have insulated throats.

G. Liquid Tight Flexible Conduit:

1. Requirements same as for flexible conduit.
2. Use in areas where environment is damp or could become damp or wet.
3. To contain an equipment grounding conductor with phase conductors. Bond grounding conductor to equipment served and nearest conduit system junction box.
4. Manufacturer: CONTRACTOR option.
5. Usage:

a. Use in conjunction with galvanized rigid metal conduit.
b. Use in conjunction with PVC coated galvanized rigid metal conduit.

6. Conduit:

a. Single strip, helically wound, galvanized steel core inside and outside with smooth interior surface with sunlight resistant thermoplastic jacket suitable for ambient environmental conditions conforming to applicable UL Standards.
b. Jacket shall be positively locked to core to prevent sleeving.
c. All runs of flexible conduit shall be as short as practicable, of the same size as the conduit it extends and with enough slack to reduce the effects of expansion and vibration.

7. Fittings:

a. Where used in conjunction with galvanized rigid metal conduit, connectors shall be malleable iron or steel, electro zinc plated, with insulated throat and taper threaded hub.
b. Where used in conjunction with PVC coated galvanized rigid metal or rigid aluminum conduit connectors shall be malleable iron or steel, electro zinc plated and PVC coated, with insulated throat and taper threaded hub.
c. Particular attention shall be given to maintaining ground bond and firm support through flexible connections.
d. All fittings shall be liquid tight.

H. Nonmetallic Conduit (PVC):

1. Where indicated on drawings.
2. In or under concrete slabs.

3. PVC conduit may be used for low voltage wiring (24 volts or less), where allowed by code. PVC may not be used in plenum rated ceilings or if another type has been called out on the drawings.
4. Where PVC conduit penetrates floor, it must be installed per conduit installation detail.
5. PVC not allowed indoors above slab, except for single ground conductors in non-plenum areas.
6. Manufacturer:

    a. Carlon.
    b. Or equal.

7. Conduit:

    a. Made from polyvinyl chloride compound (recognized by UL), which includes inert modifiers to improve weatherability and heat distortion.
    b. Rated for use with 90 degree C conductors. Material shall comply with NEMA Specification TC-2.
    c. The conduit and fittings shall be homogeneous plastic material free from visible cracks, holes or foreign inclusions. The conduit bore shall be smooth and free of blisters, nicks or other imperfections, which could mar conductors or cables.
    d. Conduit, fittings and cement shall be produced by the same manufacturer to assure system integrity.

8. Conduit Bodies:

    a. Made from polyvinyl chloride compound (recognized by UL), which includes inert modifiers to improve weatherability and heat distortion.
    b. Rated for use with 90 degree C conductors. Material shall comply with NEMA Specification TC-3.
    c. Stainless steel hardware.
    d. Cover constructed of same material with solid gasket.

9. Fittings:

    a. Made from polyvinyl chloride compound (recognized by UL), which includes inert modifiers to improve weatherability and heat distortion.
    b. Rated for use with 90 degree C conductors. Material shall comply with NEMA Specification TC-3.

I. MC Cable

1. Manufacturer: Contractor’s Option.
2. MC Cable: Interlocked steel sheath with grounding conductor. All conductors to be stranded copper, including the ground.
3. Flexible metallic covered cable may be used in the following locations:

    a. Building interior walls where interior walls are constructed of drywall over wood or metal studs. Flexible cable may be run from outlet to outlet horizontally in the walls. Where conduit exits top of wall, this shall be connected to a junction box within 24”, and from that point, conduit shall be used.

b. MC cable may only be used in those walls that reach to the ceiling. It may not be used in partial height walls. It may not be used in any exposed ceiling areas.
c. MC cable shall be supported with steel straps that are designed for the cable diameter being installed.

2.3 METAL CONDUIT

A. Rigid Steel Conduit: ANSI C80.1.

B. Intermediate Metal Conduit (IMC): Rigid steel.

C. Fittings and Conduit Bodies: ANSI/NEMA FB 1; material to match conduit all steel fittings.

2.4 PVC COATED METAL CONDUIT

A. Description: NEMA RN 1, rigid steel conduit with external PVC coating, 40 mil thick.

B. Fittings and Conduit Bodies: ANSI/NEMA FB 1, steel fittings with external PVC coating to match conduit.

2.5 FLEXIBLE METAL CONDUIT

A. Description: Interlocked steel construction.

B. Fittings: ANSI/NEMA FB 1.

2.6 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Description: Interlocked steel construction with PVC jacket.

B. Fittings: ANSI/NEMA FB 1 with insulated throats.

2.7 ELECTRICAL METALLIC TUBING (EMT)

A. Description: ANSI C80.3; galvanized tubing.

B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel or malleable iron, insulated throat connectors.

2.8 NONMETALLIC CONDUIT

A. Description: NEMA TC 2; Schedule 80 PVC.

B. Fittings and Conduit Bodies: NEMA TC 3.

2.9 WIREWAYS

A. Description: General purpose type wireway.

B. Knockouts: Bottom only.

C. Size: As required.

D. Cover: Hinged.

E. Connector: Slip-in.

F. Fittings: Lay-in type with removable top, bottom and sides with captive screws.

G. Finish: Rust inhibiting primer coat with gray enamel finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify routing and termination locations of conduit prior to rough in.

B. Verify conduit routing. Routing as shown on Drawings is in approximate locations unless dimensioned. Route as required to complete wiring system.

3.2 FIELD MEASUREMENTS

A. Field verify all measurements. Do not base conduit rough-in or equipment locations on dimensions obtained from the contract drawings.

B. Identify conflicts with the work of other trades prior to installation of electrical equipment and conduit work.

C. Adjust conduit system installation to satisfy field requirements.

3.3 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Accept conduit on site. Inspect for damage.

C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

D. Protect PVC conduit from sunlight.

3.4 INSTALLATION

A. General:

1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer's recommendations.
2. Install all materials, assemblies and equipment in strict accordance with manufacturer's recommendations and instructions. Consult manufacturer for all wiring diagrams, schematics, sizes, outlets, etc. before installing.
3. All conduit shall be installed in building unless indicated otherwise.
4. All conduits stubbed into ceiling shall have end bushings.
5. Install conduit in accordance with NECA "Standard of Installation."
6. Install nonmetallic conduit in accordance with manufacturer's instructions.
7. Arrange supports to prevent misalignment during wiring installation.
8. Support conduit using coated steel or malleable iron straps, lay in adjustable hangers, clevis hangers, and split hangers.
9. Group related conduits: support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.
10. Fasten conduit supports to building structure and surface under provisions of Section 26 05 29.
11. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
12. Do not attach conduit to ceiling support wires.
13. Arrange conduit to maintain headroom and present neat appearance.
14. Route exposed conduit parallel and perpendicular to walls.
15. Route conduit in and under slab from point to point.
16. Do not cross conduits in slab.
17. Maintain adequate clearance between conduit and piping.
18. Maintain 12 inch clearance between conduit and surfaces with temperatures exceeding 104 degrees F.
19. Cut conduit square using saw or pipecutter; de burr cut ends.
20. Bring conduit to shoulder of fittings; fasten securely.
21. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cleaner and cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
22. Use conduit hubs to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
23. Install no more than equivalent of three 90 degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Hydraulic one-shot bender may be used to fabricate factory elbows.
24. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
25. Provide suitable fittings to accommodate expansion and deflection where conduit crosses control and expansion joints.
26. Provide suitable pull string in each empty conduit, except sleeves and nipples.
27. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
28. Ground and bond conduit under provisions of Section 26 05 26.
29. Identify conduit under provisions of Section 26 05 53.
30. Flexible metal conduit shall be used for connection to equipment subject to vibration and light fixture drops in all removable tile ceilings. Length shall not exceed 36" for equipment connections and 72" for light fixture connections. Minimum size 1/2", except

3/8" may be used for fixture drops. Install flexible conduit drops from independent junction box mounted above ceiling and accessible from below ceiling to recess ceiling mounted equipment. Allow for positioning of equipment to next tile increment.

31. Seal conduit with oakem or duct seal where they leave heated areas and enter unheated areas.
32. Surface raceway shall be installed to run parallel of all existing surfaces. Where raceway is used on ceiling, raceway shall be mounted at ceiling wall junction and extended from the junction box out to ceiling mounted device. Raceway shall be routed in corners and along mouldings to be as least obtrusive as possible.
33. Exterior cable and conduit installation.

    a. Layout in trench may be started at either end unless the drawings indicate that it is to pitch for drainage. In which case the layout should be started at the lowest end. The cable and conduit shall be pitched 1" per 100 feet.
    b. Include all excavation and backfill.
    c. Cable and conduit shall be a minimum of 30" deep.
    d. Cable and conduit shall be laid in a 6" sand bed and covered with another 6" of sand before backfilling with earth.
    e. Provide Brady identotape 12" above all buried conduits and cables.
    f. Provide #12 pull wire in all empty or spare conduits.
    g. Restore existing surface back to its original condition.
    h. For all excavation, maintain erosion protection per Federal, State, and municipal requirements. All work associated with erosion control for excavation shall be done as per Federal, State and municipal requirements, as well as any plans, meetings, and other special conditions.
    i. For all trenching that is under paved surfaces, backfill with structural material. Material shall be tapped in layers up to the point of the surface paving material.

34. For intermediate floor structural slabs, assume that conduit cannot be installed within the slab. If installing conduit within the slab, coordinate this with the Construction Manager and verify with the Architect prior to installation.
35. For on-grade slabs, the conduit may be run in or under the slab. Verify with concrete installation prior to running conduits in slab to determine if that conduit coordinates with the slab reinforcing.

B. Conduits Stubbed into Ceiling Space

1. All conduits stubbed into ceiling shall have end bushings or insulated connectors.

C. Service Entrance Conduit

1. All joints and couplings of buried service entrance conduits shall be taped and coated with an electrical insulating and sealing compound to make them watertight.

D. Exterior Wall Penetrations

1. For all exterior wall penetrations, patch the wall with material to match the existing wall finish. The openings shall be as small as possible to minimize the impact on the existing wall finish. Install duct seal within the conduit to prevent air flow.

2. When conduits are rising from the ground to penetrate the walls, furnish rigid steel conduit where conduit is exposed, and deep-back LB's condulettes or NEMA 4X stainless steel junction box.

E. Interface with Other Products

1. Install conduit to preserve fire resistance rating of partitions and other elements.
2. Route conduit through roof openings for piping and ductwork or through suitable roof jack. Coordinate location with roofing installation.

F. Solid Core Precast Concrete Panels

1. Where outlet boxes are shown on solid-core, precast concrete wall panel, raceway shall be cast in panel. See specification section 26 05 01 Project Special Conditions for additional information.

3.5 OWNER TRAINING (NONE)

3.6 SPARE EQUIPMENT (NONE)

END OF SECTION 260534

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SECTION 260535 - ELECTRICAL BOXES

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.2 APPLICABLE PUBLICATIONS

A. Conform to requirements of current ANSI/NFPA 70 - National Electric Code.

B. Conform to current National Electrical Manufactures Association (NEMA) Standards.

C. Conform to current Underwriters Laboratories (UL) Specifications and Standards.

D. Conform to National Electrical Contractors Association (NECA) “Standards of Installation”.

1.3 DESCRIPTION OF WORK

A. Furnish and install boxes as indicated on drawings and specified herein.

B. The intent of this section is to limit the use of sheet steel boxes to small circuit wiring in dry locations for installations of outlets, switches, exhaust fans, lights, unit heaters, small overhead door units, small power outlets, and limiting the general circuit capacity of 50 amps or less.

C. Outlets, switches, controls and etc., installed on machinery or processes shall be served with FS and NEMA 12 type boxes.

1.4 RELATED WORK ELSEWHERE

A. Division 03: Concrete

B. Division 04: Masonry

C. Division 09: Finishes

D. Division 12: Furnishing

E. Division 23: Heating, Ventilation and Air Conditioning

F. Division 26, 27, and 28: Electrical

1.5 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

1.6 OPERATION & MAINTENANCE MANUALS

A. Submit Operations & Maintenance Manuals in accordance with Section 26 05 04.

1.7 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. All materials, equipment and parts are to be new, undamaged and unused of current Manufacture.

1.8 WARRANTY

A. Equipment shall be warranted for a period of not less than 1 year from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

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.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials and equipment shall be new (less than 1 year old when turned over to the Owner).

2.2 BOXES

A. Pull boxes and junction boxes: Metal construction, conforming to National Electrical Code, with screw on or hinged cover.

B. Flush mounted pull boxes: Provide overlapping covers with flush head cover retaining screws, prime coated.

C. Small surface type junction boxes to be used in dry locations only for general purpose lighting and outlets shall conform to the following standard sizes and spec's:

1. All boxes and covers shall be made of stamped steel. (No sectional boxes allowed).
2. Minimum sizes:

a.	Handy boxes	4 x 2 1/8 x 2 1/8
b.	Octagon boxes	4 x 1 1/2
c.	4" sq. boxes	4 x 1 1/2 or 4 x 2 1/8
d.	4 11/16" sq. boxes	4 11/16 x 2 1/8

D. Flush mounted outlet boxes used in dry locations shall conform to the following standards:

1. All boxes and covers shall be made of stamped steel. No sectional boxes allowed.
2. All boxes for communications outlets and blank outlets shall be of the "deep" variety.
3. Minimum sizes:

   a. Masonry boxes: minimum 3 1/2" deep, gang as required. These can be used for outlets or blank outlets.
   b. 4" square wiring device boxes: 2 1/8" deep when used for communication or blank outlets. 1 1/2" or 1 1/8" deep when used for wiring devices. All 4" square boxes shall be equipped with square cut 1" raised covers of appropriate depth.
   c. Note special requirements for boxes that will be used in corrosive atmospheres, such as pools. In these atmospheres use corrosion resistant (PVC) outlet boxes.
   d. Note special requirements for flush boxes for outside receptacles. These boxes shall be 4-hole type or other type to properly patch the surface weather tight covers.

E. Junction and Splice Boxes:

1. Screw covers, galvanized after fabrication and not less than code dimensions.
2. Entry openings in boxes shall be made with knock-out punch tool or hole saws.
3. Burning of entry openings with a torch will not be acceptable.
4. Paint exposed ferrous surfaces, 2 coats rust resisting paint.

F. Flush interior devices shall utilize 4" square box with raised covers or deep masonry boxes as appropriate.

G. Raised covers to have square cut corners.

H. Box extensions will not be allowed.

I. Through the wall type outlet boxes not allowed.

J. Junction boxes and pull boxes shall not have knockouts. Enclosure type, material, and dimensions shall be as indicated on the drawings and as stated in these specifications. Where no type or size is indicated for junction boxes and pull boxes, they shall be one size larger than required by NEC.

K. For exterior outlets, such as receptacles, use FS type outlet box flush mounted.

L. Large junction boxes shall be constructed from steel in the following gauges:

Box Size	Minimum Steel Gauge
Up to 24" x 30" x 12"	14
24" x 36" x 8" to 36" x 36" x 16"	12
36" x 42" x 8" and larger	11

M. Boxes that are shown on solid-core, precast concrete wall panel shall be flush mounted in the panel. See specification 26 05 01 Project Special Conditions for additional information.

2.3 WET LOCATION JUNCTION BOXES

A. All deck junction boxes used in submersible and wet locations shall be cast bronze construction with navel brass cord seal, neoprene cover gasket and internal grounding lugs.

B. All conduit entries into the junction box shall be threaded into the junction box housing.

C. All conduit entries shall be sealed with a potting compound and caulking material.

D. Approved equipment.

1.	Above grade double hub	Hydrel 1719
2.	Flush double entry junction box	Hydrel 1703
3.	Flush multiple entry junction box	Hydrel 1705

2.4 FLOOR BOXES

A. Type A Cast-in-Place Concrete Floor Box, On-grade with devices:

1. Four compartment, dual service steel floor box with epoxy covering.
2. Provide separate conduit runs to floor box to accommodate both communication devices and 120 volt or other line voltage devices as shown.
3. Box to have ¾”, 1", and 1-1/4" knockouts.
4. Provide device plates as appropriate for devices being installed per floor plans. For those devices that are being installed that do not have specific plates, provide blank plate and cut opening in plate to support device.
5. Architect to select floor box cover color and type (with flooring insert)
6. Wiremold floor box.

a.	Floor box:	RFBA4R30OG
b.	Duplex receptacle bracket:	RFBADP
c.	Blank bracket:	RFBAB
d.	Communication bracket:	RFBA6A
e.	Flanged cover with flooring insert:	FPCTCXX

B. Type B – Cast-in-Place Concrete Floor Box, On-grade furniture feed

1. Four compartment, dual service steel floor box with epoxy covering.
2. Provide separate conduit runs to floor box to accommodate both communication devices and 120 volt or other line voltage devices as shown.
3. Box to have ¾”, 1", and 1-1/4" knockouts.

4. Wiremold floor box.

a.	Floor box:	RFBA4R30OG
b.	Flanged cover:	FPFFTCBK (black)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify routing and termination locations of conduit prior to rough in.

3.2 FIELD MEASUREMENTS

A. Verify that field measurements are as shown on Drawings.

B. Mounting heights:

1. As shown on drawings and details.
2. Coordinate exact heights with specific manufacturer's recommendations.
3. All mounting heights of keypads and pushbuttons to be ADA compliant.

3.3 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Maintain original quality and condition of equipment while it is in storage.

3.4 INSTALLATION

A. General:

1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer's recommendations.
2. Install all materials, assemblies and equipment in strict accordance with manufacturer's recommendations and instructions. Consult manufacturer for all wiring diagrams, schematics, sizes, outlets, etc. before installing.

B. All fire alarm pull and junction boxes and their covers shall be painted red and have "fire alarm" written on the cover in large black non-washable ink. The lettering shall be such that it can be read from 10' away. Note that this requirement is in addition to the NEC requirements which requires that the box itself be marked in red.

C. Boxes that are being installed in rough masonry surfaces (such as split face block) shall be installed in such a manner to allow the wiring device or light fixture and the associated device plate to be seated squarely. Have the masonry opening cut to the size of the plate and then box grouted in, or the rough masonry around the box shall be chiseled away and mortar installed around the box to provide a flat finish.

D. Coordinate with the masonry installation all details of installation on rough masonry surfaces. Without coordination assume responsibility for all costs to provide the flat surface, which will require chiseling the surface of the rough masonry away and providing mortar to obtain this smooth finish.

E. Install electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.

F. Install electrical boxes to maintain headroom and to present neat mechanical appearance.

G. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

H. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.

I. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods compatible with NFPA.

J. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices with each other.

K. Use flush mounting outlet boxes in finished areas.

L. Do not install flush mounting boxes back to back in walls; provide minimum 6 inch separation. Provide minimum 24 inches separation in acoustic rated walls.

M. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

N. Use stamped steel bridges to fasten flush mounting outlet box between studs.

O. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

P. Use adjustable steel channel fasteners for hung ceiling outlet box.

Q. Do not fasten boxes to ceiling support wires.

R. Support boxes independently of conduit.

S. Use gang box where more than one device is mounted together. Do not use sectional box.

T. Use 2 gang box with plaster ring for single telecommunication outlets.

U. Use cast outlet box in exterior locations exposed to the weather and wet locations.

V. Use cast floor boxes for installations in slab on grade; formed steel boxes are acceptable for other installations.

W. Set floor boxes level.

X. Large Pull Boxes: Boxes larger than 100 cubic inches in volume or 12 inches in any dimension.

1. Interior Dry Locations: Use hinged enclosure.
2. Other Locations: Use surface mounted cast metal box.

Y. Grounding

1. All equipment shall be grounded in accordance with NEC, these specifications and drawings, and the equipment supplier's recommendations.

Z. Interface with Other Products

1. Coordinate masonry cutting to achieve neat opening.
2. Coordinate mounting heights and locations of outlets mounted above counters, benches and backsplashes.
3. Position outlet boxes to locate luminaires as shown on reflected ceiling plan.

3.5 OWNER TRAINING (NONE)

3.6 SPARE EQUIPMENT (NONE)

END OF SECTION 260535

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SECTION 260537 - LOCATION OF OUTLETS AND EQUIPMENT

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.2 APPLICABLE PUBLICATIONS

A. Conform to requirements of current ANSI/NFPA 70 - National Electric Code.

B. Conform to National Electrical Contractors Association (NECA) “Standards of Installation”.

1.3 DESCRIPTION OF WORK

A. Furnish and install a complete installation as indicated on the drawings and as specified herein.

B. This specification lays out the general requirements for heights of devices. Heights of devices may be required to be changed depending on interferences in the walls or interferences with mechanical or other architectural equipment. Assume responsibility for verifying the existing conditions in the room by reviewing mechanical and architectural drawings so as not to interfere with that equipment.

C. Verification of door swings. Assume responsibility to verify door swings with the architectural plans prior to outlet box installation. Review if the switch location is such that it can be easily accessed upon opening the door.

1.4 RELATED WORK ELSEWHERE

A. Division 03: Concrete

B. Division 04: Masonry

C. Division 09: Finishes

D. Division 12: Furnishing

E. Division 23: Heating, Ventilation and Air Conditioning

F. Division 26, 27, and 28: Electrical

1.5 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

1.6 OPERATION & MAINTENANCE MANUALS (NONE)

1.7 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. All materials, equipment and parts are to be new, undamaged and unused of current manufacture.

C. All boxes to be plumb and level.

1.8 WARRANTY

A. Equipment shall be warranted for a period of not less than 1 year from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

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.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials and equipment shall be new (less than 1 year old when turned over to the Owner).

2.2 EQUIPMENT

A. Specifications for equipment being installed under conditions set forth in this section shall be found in related work elsewhere.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify installation locations suitability and adjust as directed.

3.2 FIELD MEASUREMENTS

A. Verify that field measurements are as shown on Drawings.

B. Mounting heights:

1. As shown on drawings and details.
2. Coordinate exact heights with specific manufacturer’s recommendations.
3. All mounting heights of keypads and pushbuttons to be ADA compliant.

3.3 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section prior to installation.

3.4 INSTALLATION

A. General:

1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer’s recommendations.
2. Install all materials, assemblies and equipment in strict accordance with manufacturer’s recommendations and instructions. Consult manufacturer for all wiring diagrams, schematics, sizes, outlets, etc. before installing.

B. Grounding

1. All equipment shall be grounded in accordance with NEC, these specifications and drawings, and the equipment supplier’s recommendations.

C. Location:

1. Location of outlets and equipment as shown on plans is approximate. Verify exact location determined by:

    a. Construction or code requirements.
    b. Conflict with equipment of other trades.
    c. Equipment manufacturer's drawings.

2. Minor modification to the location of outlets and equipment is considered a part of this specification and shall be made with no additional compensation.
3. Mounting heights for all devices and equipment to be measured from finished floor to center of device and unless otherwise noted on plans shall be as follows:

Switches	42"	
Receptacles	22"	
Above Counter receptacles	-	mount just above backsplash for above counter outlets. See floor plan general notes.
Range outlets	-	1" to bottom above finished floor
Communication outlets	-	to match adjacent receptacle outlet. If receptacle outlet is not shown, provide 22" above floor to center of device or 8" above counter.
Wall Speakers	88"	to top of box
Volume Control	42"	
Fire Alarm Notification Device	82"	above the floor (shall be to the highest point in the space i.e. above highest riser level) or 6" below ceiling (whichever is lower)
Fire Alarm Pull Station	42"	
Blank Outlets	-	to match receptacle height located adjacent to it unless stated otherwise on plans
Keypads	42"	unless shown otherwise on details
Card Reader	42"	unless shown otherwise on details

D. Check Heating and Ventilating Plans for location of baseboard heating elements or wall radiators and mount equipment accordingly.

E. Receptacles below counter: Verify the actual mounting height with architect. Determine if device is to fit into knee space and rough-in accordingly.

F. Office Electrical Devices

1. In each of the office spaces shown, the Owner will provide an actual layout of the room.
2. Electrical devices shall be rearranged in these rooms to accommodate the equipment.
3. Whenever the front counter is shown with receptacles within it, work with the counter manufacturer to cut the receptacles into the secretarial side of the counter.
4. These receptacles shall be cut into the face of the cabinet.
5. Provide all cutting and installation.
6. Counters shall be fed through the wall or through the floor.

3.5 OWNER TRAINING (NONE)

3.6 SPARE EQUIPMENT (NONE)

END OF SECTION 260537

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SECTION 260553 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.2 APPLICABLE PUBLICATIONS

A. Conform to requirements of current ANSI/NFPA 70 - National Electric Code.

B. Conform to National Electrical Contractors Association (NECA) “Standards of Installation”.

1.3 DESCRIPTION OF WORK

A. Furnish and install complete labeling as specified herein.

B. All major pieces of electrical equipment shall have engraved labels indicating their functions. This shall include the following:

1. All pushbuttons shall have labels that are engraved as to its function.
2. All contactor enclosures shall indicate what the contactor’s function is.
3. Provide engraved tags for all air handling units, including HVAC units. Each unit shall be adequately marked with a tag indicating what unit number it is. An engraved tag shall also be provided on all air handling units which have smoke detector shut down. This tag shall indicate the following: "This air handler is equipped with smoke detector shut down. In the event that smoke is sensed in the ductwork, the air handler will turn off".
4. All panelboards, starters, disconnects, transfer switches, switchboards, motor control centers and transformers shall have engraved labels indicating their functions.
5. Provide engraved tags for all special pull and junction boxes that are associated with the building special systems.
6. Provide all spare keys and tags as indicated for keyed switches.

C. Low Voltage Systems

1. Provide labeling for all low voltage cabling, both ends within 3” of termination point and low voltage device plates. Color coding to be maintained for each system independently.
2. Each component of the system to be clearly marked as to manufacturer, part number, and any special designation on drawing.
3. All patchpanels, racks, and modular plates in patchpanels to be labeled.

1.4 RELATED WORK ELSEWHERE

A. Division 23: Heating, Ventilation and Air Conditioning

B. Division 26, 27, and 28: Electrical.

1.5 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

1.6 OPERATIONS & MAINTENANCE MANUALS

A. Submit Operations & Maintenance Manuals in accordance with Section 26 05 04.

1.7 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. All materials, equipment and parts are to be new, undamaged and unused of current Manufacture.

1.8 WARRANTY

A. Equipment shall be warranted for a period of not less than 1 year from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials and equipment shall be new (less than 1 year old when turned over to the Owner).

2.2 ENGRAVED LABELS

A. Where the words "provide engraved label" appears on the drawings or in the specifications, it shall mean that the label shall be an engraved 3-layer phenolic label with black letters on white material, unless other colors are called out on the drawings or details.

B. The label size shall be a minimum of 3/4" high and be 3" long. Labels may be attached with double backed adhesive tape unless indicated otherwise.

C. Where references are made on the drawings to provide engraved labels, engraved nameplate or engraved plates, these should be engraved phenolic labels.

2.3 ENGRAVED PLATES

A. Where references are made to engraved plates, this shall mean that the normal device plate shall have an engraving on it with black letters so as to indicate what this switch or device is used for.

2.4 BRANCH CIRCUIT OUTLETS: LABELING

A. Each branch circuit outlet, receptacles, lighting, and any other device requiring 120/208/277 or 480 volt power, the contractor shall:

1. Provide circuit, written in pencil or non-washable ink, inside of outlet box in an area that can be easily viewed when removing outlet faceplate.
2. Write circuit number in ink on device between receptacles under plate.
3. Optional: Provide typed label (not dyno label) for each circuit attached to device plate.
4. Label each junction box outlet cover in non-washable marker as to circuit number routed through junction box.

2.5 PANELBOARDS: LABELING

A. Panelboard Directory:

1. Prepare and affix a typewritten directory to the inside cover of each panelboard indicating loads controlled by each circuit.
2. Each distribution and lighting panelboard shall be equipped with a typewritten directory accurately indicating rooms and/or equipment being served.
3. Assume that originally directories will have to be developed based on the room numbers on the project drawings.
4. Near project completion, all directories will have to be changed to reflect actual room numbers as designated by the building occupant.
5. Include the cost of doing the original handwritten directory and revisions to the directory based on occupant room numbers.

B. Panelboard Identification:

1. Label per NEC 210.5.
2. Identify each panel with a suitably engraved nameplate mounted at the top of the front cover.
3. The nameplates shall be made of laminated black and white plastic with white on the outside.
4. The lettering shall be 1/4 inch high (minimum), engraved by cutting through the white outside layer so that the letters appear black.
5. Fasten nameplates with brass or stainless steel panhead screws.
6. Nameplate engraving shall match the numbers or letters shown on the drawings or assigned by the Owner's Representative.
7. Labels shall be engraved as to the function of the circuit breaker.
8. Labels shall also be engraved to indicate the load served by the circuit breaker.

C. Identify the source of the feeder circuit serving the panelboard.

2.6 SWITCHBOARDS AND POWER DISTRIBUTION PANELS

A. Each switchboard and power panel that does not have a front hingeable door shall have an engraved laminated label attached adjacent to each circuit breaker.

B. The label shall be engraved as to the function of that circuit breaker and the load served by that circuit breaker.

2.7 STARTERS AND DISCONNECTS

A. Each starter and disconnect furnished by this section or furnished by other sections but installed by this section shall have an engraved laminated label indicating which piece of equipment it controls.

B. This requirement is waived if the disconnect or starter is attached directly to the piece of equipment that it is controlling or operating.

2.8 FIRE ALARM SYSTEM

A. Each new fire alarm system junction and pull boxes and covers shall be identified by having it marked with red paint. Additional identification shall be included as follows:

1. The flat cover shall also be painted red with the words "Fire Alarm" clearly indicated on it.
2. The letters shall be a minimum of 1 1/2" high.
3. Handwritten letters may be used above ceilings or where otherwise concealed, stenciled covers shall be used where exposed, such as closets, mechanical rooms, etc.
4. This marking is in addition to the NEC required marking.

2.9 TERMINAL BOXES

A. Those devices as indicated as terminal boxes, junction, or pull points that have internal terminal strips. Each terminal box shall:

1. Be identified on the outside of its cover as to its function.
2. Have an engraved laminated label attached to the outside of its cover which identifies its function.
3. Have terminal strips permanently marked with a numbering system that corresponds to the drawings furnished for the system.
4. Have each wire terminating on the terminal strip identified as to its wire number which is identified on the wiring diagram for this system.

B. Refer to wire marker, this section, as to the type of wire number required.

2.10 COMMUNICATIONS SYSTEM CABLES IDENTIFICATION

A. Communication system cables are defined as:

1. All low voltage cabling, not 120 volt.

B. Each wire or cable that is furnished and installed for the above systems shall be identified at each end of the cable using the same identification marker at both ends, within 3” of termination point.

C. The identification shall be the same that is furnished by the contractor in his submittal documents.

D. Labels shall be overwrap type “Panduit PLL or PDL type” or equal labels by Brady.

2.11 COMMUNICATIONS SYSTEM DEVICES

A. Communication system devices are designated as:

1. Data outlets in rooms.
2. Data outlets at patchpanel.

B. Each label shall be a computer generated, laser printed, adhesive type label; either clear or white.

C. The labels shall be attached to each of the plates so that the device on the plate can be easily identified.

D. Provide Panduit PLL series type label, or equal by Brady.

2.12 MISCELLANEOUS

A. Branch circuits

1. On branch circuits, use shall be made of all standard wire insulation colors available.
2. Where wires of different systems junction in a common box, each cable shall be grouped with its own system and identified using tags or identification strips.

B. Special systems

1. All control, instrumentation, graphic display, alarm and other special system wires shall be clearly identified by description and location, using tags or identification strips.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify surfaces are cleaned and ready to receive labels.

B. Verify labels are correct.

C. Verify that labels are installed as specified, level and plumb.

3.2 FIELD MEASUREMENTS (NONE)

3.3 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

3.4 INSTALLATION

A. General:

1. Degrease and clean surface prior to installing labels.
2. Install nameplate and label parallel to equipment lines.
3. Secure nameplates to equipment fronts using screws if so specified on drawings.
4. Identify Raceways of Certain Systems with Color Banding:

    a. Band exposed or accessible raceways of the following systems for identification.
    b. Bands shall be pretensioned, snap-around colored plastic sleeves, colored adhesive marking tape, or a combination of the two.
    c. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
    d. Install bands at changes in direction, at penetrations of walls and floors, and at 40-foot maximum intervals in straight runs.

3.5 OWNER TRAINING (NONE)

3.6 SPARE EQUIPMENT (NONE)

END OF SECTION 260553

SECTION 260573 - ELECTRICAL SYSTEMS STUDIES

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work under this Section.

1.2 APPLICABLE PUBLICATIONS

A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent applicable.

1. American National Standards Institute/National Fire Protection Agency (ANSI/NFPA), Specifications and Standards, current edition:

    a. NFPA 70 - National Electrical Code.
    b. NFPA 70E - Standard for Electrical Safety in the Workplace

2. Institute of Electrical and Electronics Engineers (IEEE), Specifications and Standards, current edition:

    a. IEEE 141 - Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
    b. IEEE 241 - Recommended Practice for Electric Power Systems in Commercial Buildings
    c. IEEE 242 - Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
    d. IEEE 399 - Recommended Practice for Industrial and Commercial Power System Analysis
    e. IEEE 1015 - Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
    f. IEEE 1584 -Guide for Performing Arc-Flash Hazard Calculations

1.3 DESCRIPTION OF WORK

A. Furnish a short-circuit study to determine required interrupting current rating for normal and optional standby systems.

B. Furnish a protective device coordination study for the optional standby system. Study both normal and optional standby power sources.

C. Furnish an Arc Flash Hazard Analysis Study per the requirements set forth in the current issue of NFPA 70E -Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the IEEE Standard 1584 - 2002, the IEEE Guide for Performing Arc-Flash Calculations. This is required for normal and optional standby systems.

1.4 RELATED SECTIONS

A. Section 26 24 13 - LOW VOLTAGE SWITCHBOARDS

B. Section 26 24 16 - PANELBOARDS

C. Section 26 27 28 - CIRCUIT & MOTOR DISCONNECTS

D. Section 26 32 00 - STANDBY ENGINE/GENERATOR SET

E. Section 26 36 00 - TRANSFER SWITCH

1.5 SUBMITTALS

A. Submit shop drawings in accordance with Division 01.

B. Preliminary short-circuit and protective device coordination studies shall be submitted and approved prior to the approval of any electrical equipment submittals that may be affected by the results of the study.

C. Final short-circuit, protective device coordination, and arc flash hazard analysis studies shall be prepared and submitted based upon actual installed system characteristics.

D. Submit the following information specifically for Electrical Systems Analysis:

1. The results of the short-circuit, protective device coordination, and arc flash hazard analysis studies shall be summarized in a final report. A minimum of five (5) bound copies of the complete final report shall be submitted. Electronic PDF copies of the report shall be provided.
2. The report shall include the following sections:

    a. Executive Summary including Introduction, Scope of Work and Results/Recommendations.
    b. Short-Circuit Methodology Analysis Results and Recommendations
    c. Short-Circuit Device Evaluation Table
    d. Protective Device Coordination Methodology Analysis Results and Recommendations
    e. Protective Device Settings Table
    f. Time-Current Coordination Graphs and Recommendations
    g. Arc Flash Hazard Methodology Analysis Results and Recommendations including the details of the incident energy and flash protection boundary calculations, along with Arc Flash boundary distances, working distances, Incident Energy levels and Personal Protection Equipment levels.
    h. Arc Flash Labeling section showing types of labels to be provided. Section shall contain descriptive information as well as typical label images.
    i. One-line system diagram that shall be computer generated and will clearly identify individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location, device numbers used in the time-current coordination analysis, and other information pertinent to the computer analysis.

3. Submit an electronic version of the software model used to prepare the final short-circuit, protective device coordination, and arc flash hazard analysis studies.

1.6 FACTORY TESTING - NOT USED

1.7 OPERATION/MAINTENANCE MANUALS AND INSTRUCTIONS- NOT USED

1.8 QUALITY ASSURANCE

A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the responsible charge and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.

B. The Registered Professional Electrical Engineer shall be an employee of the approved engineering firm.

C. The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies.

D. The approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analyses it has performed.

E. The studies shall be performed using SKM Systems Analysis Power*Tools for Windows (PTW) software program or an approved equivalent software tool.

PART 2 - PRODUCTS

2.1 DATA COLLECTION

A. Field data collection shall be performed by a technician, qualified (as defined by NFPA 70E - 2004) to ensure accurate equipment modeling. The technician shall have completed an 8-hour instructor-led Electrical Safety Training Course. The course shall include NFPA 70E training which includes the selection and use of personal protective equipment.

B. The technician shall visually inspect to verify the equipment ratings, conductor ratings and overcurrent device data by removing panels, covers and doors where required to document the necessary data used in the analysis. The technician shall be qualified to perform these inspections with the equipment energized provided the incident energy values are less than 40cal/cm², greater values or unusual site conditions will require an equipment shutdown so the equipment can be inspected de-energized.

C. The Owner or Contractor shall provide qualified personnel to show the technician the equipment locations and to open all equipment doors, locks, etc. necessary to collect nameplate data.

D. Verify one-line drawings and provide marked corrections where discrepancies are found..

E. Data collection shall begin downstream from the utility service and continue down through the electrical distribution system as defined under scope of work. The study shall not include any single phase AC circuits or DC distribution systems as these types of circuits and systems are excluded from IEEE 1584-2002 Arc Flash calculation guidelines. The study need not include equipment rated 240 volts or less per NFPA 70E, when supplied by a single transformer rated less than 125kVA.

F. Obtain from the utility the minimum, normal, and maximum operating service voltage levels, three-phase short circuit MVA and X/R ratio, as well as line-to-ground short circuit MVA and X/R ratio at the point of connection as shown on the drawings.

2.2 SHORT-CIRCUIT ANALYSIS

A. Transformer design impedances shall be used when test impedances are not available.

B. Provide the following:

1. Calculation methods and assumptions
2. Selected base per unit quantities
3. One-line diagram of the system being evaluated that clearly identifies individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location and other information pertinent to the computer analysis
4. The study shall include input circuit data including electric utility system characteristics, source impedance data, conductor lengths, number of conductors per phase, conductor impedance values, insulation types, transformer impedances and X/R ratios, motor contributions, and other circuit information as related to the short-circuit calculations.
5. Tabulations of calculated quantities including short-circuit currents, X/R ratios, equipment short-circuit interrupting or withstand current ratings and notes regarding adequacy or inadequacy of the equipment rating.
6. Results, conclusions, and recommendations. A comprehensive discussion section evaluating the adequacy or inadequacy of the equipment must be provided and include recommendations as appropriate for improvements to the system.

C. For solidly-grounded systems, provide a bolted line-to-ground fault current study for applicable buses as determined by the engineer performing the study.

D. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short circuit ratings
2. Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses
3. Identify in writing, any circuit protective devices improperly rated for the calculated available fault current.

2.3 PROTECTIVE DEVICE TIME-CURRENT COORDINATION ANALYSIS

A. Protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.

B. Include on each TCC graph, a complete title with descriptive device names.

C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.

D. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.

E. Plot the following characteristics on the TCC graphs, where applicable:

1. Electric utility's overcurrent protective device
2. Medium voltage equipment overcurrent relays
3. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands
4. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands
5. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves
6. Medium voltage conductor damage curves
7. Ground fault protective devices, as applicable
8. Pertinent motor starting characteristics and motor damage points, where applicable
9. Pertinent generator short-circuit decrement curve and generator damage point
10. The largest feeder circuit breaker in each motor control center and applicable panelboard.

F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

G. Provide the following:

1. A one-line diagram shall be provided which clearly identifies individual equipment buses, bus numbers, device identification numbers and the maximum available short-circuit current at each bus when known.
2. A sufficient number of log-log plots shall be provided to indicate the degree of system protection and coordination by displaying the time-current characteristics of series connected overcurrent devices and other pertinent system parameters.
3. Computer printouts shall accompany the log-log plots and will contain descriptions for each of the devices shown, settings of the adjustable devices, and device identification numbers to aid in locating the devices on the log-log plots and the system one-line diagram.
4. The study shall include a separate, tabular printout containing the recommended settings of all adjustable overcurrent protective devices, the equipment designation where the device is located, and the device number corresponding to the device on the system one-line diagram
5. A discussion section which evaluates the degree of system protection and service continuity with overcurrent devices, along with recommendations as required for addressing system protection or device coordination deficiencies.
6. Identify in writing of any significant deficiencies in protection and/or coordination. Provide recommendations for improvements.

2.4 ARC FLASH HAZARD ANALYSIS

A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2009, Annex D. The arc flash hazard analysis shall be performed in conjunction with the short-circuit analysis and the protective device time-current coordination analysis.

B. The flash protection boundary and the incident energy shall be calculated at significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.

C. Circuits 240V or less fed by single transformer rated less than 125 kVA may be omitted from the computer model and will be assumed to have a hazard risk category 0 per NFPA 70E.

D. Working distances shall be based on IEEE 1584. The calculated arc flash protection boundary shall be determined using those working distances.

E. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations

F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location in a single table. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for normal and optional standby operating conditions. The minimum calculation will assume that the utility contribution is at a minimum. Conversely, the maximum calculation will assume a maximum contribution from the utility. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable as well as any stand-by generator applications.

G. The Arc-Flash Hazard Analysis shall be performed utilizing mutually agreed upon facility operational conditions, and the final report shall describe, when applicable, how these conditions differ from worst-case bolted fault conditions.

H. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors should be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond 5 cycles.

I. For each piece of ANSI rated equipment with an enclosed main device, two calculations shall be made. A calculation shall be made for the main cubicle, sides, or rear; and shall be based on a device located upstream of the equipment to clear the arcing fault. A second calculation shall be made for the front cubicles and shall be based on the equipment's main device to clear the arcing fault. For all other non-ANSI rated equipment, only one calculation shall be required and it shall be based on a device located upstream of the equipment to clear the arcing fault.

J. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.

K. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.

L. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. A maximum clearing time of 2 seconds will be used based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

M. Provide the following:

1. Results of the Arc-Flash Hazard Analysis shall be submitted in tabular form, and shall include device or bus name, bolted fault and arcing fault current levels, flash protection boundary distances, working distances, personal-protective equipment classes and AFIE (Arc Flash Incident Energy) levels.

a. The Arc-Flash Hazard Analysis shall report incident energy values based on recommended device settings for equipment within the scope of the study.

1) The Arc-Flash Hazard Analysis may include recommendations to reduce AFIE levels and enhance worker safety.

PART 3 - EXECUTION

3.1 FIELD ADJUSTMENT

A. The Contractor or equipment manufacturer's start-up technician shall adjust relay and protective device settings according to the recommended settings table provided by the coordination study.

B. The Contractor shall make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

C. The Contractor shall notify Owner in writing of any required major equipment modifications.

3.2 ARC FLASH LABELS

A. Provide a 4.0 in. x 4.0 in. thermal transfer type label of high adhesion polyester for each work location analyzed.

B. The labels shall be designed according to the following standards:

1. UL969 - Standard for Marking and Labeling Systems
2. ANSI Z535.4 - Product Safety Signs and Labels
3. NFPA 70 (National Electric Code) - Article 110.16

C. C. The label shall include the following information:

1. System Voltage

a. Flash protection boundary
b. Personal Protective Equipment category
c. Arc Flash Incident energy value (cal/cm²)
d. Limited, restricted, and prohibited Approach Boundaries

1) Study report number and issue date

D. Labels shall be printed by a thermal transfer type printer, with no field markings.

E. Arc flash labels shall be provided for equipment as identified in the study and the respective equipment access areas per the following:

1. Floor Standing Equipment - Labels shall be provided on the front of each individual section. Equipment requiring rear and/or side access shall have labels provided on each individual section access area. Equipment line-ups containing sections with multiple incident energy and flash protection boundaries shall be labeled as identified in the Arc Flash Analysis table.
2. Wall Mounted Equipment - Labels shall be provided on the front cover or a nearby adjacent surface, depending upon equipment configuration.
3. General Use Safety labels shall be installed on equipment in coordination with the Arc Flash labels. The General Use Safety labels shall warn of general electrical hazards associated with shock, arc flash, and explosions, and instruct workers to turn off power prior to work.

F. Label Installation

1. Labels shall be field installed by the Contractor. The technician providing the installation shall have completed an 8-Hour instructor led Electrical Safety Training Course with includes NFPA 70E material including the selection of personal protective equipment.

3.3 TRAINING - NOT USED

END OF SECTION 260573

SECTION 260923 - LIGHTING CONTROLS

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.2 APPLICABLE PUBLICATIONS

A. Conform to requirements of current ANSI/NFPA 70 National Electrical Code.

B. Conform to current National Electrical Manufactures Association (NEMA) Standards.

C. Conform to current Underwriters Laboratories (UL) Specifications and Standards.

D. Conform to current NEMA Enclosure Standards.

E. Conform to NEMA Standard WD-7-2000.

1.3 DESCRIPTION OF WORK

A. Furnish and install a complete lighting control system as shown on the drawings and as specified herein. This equipment shall provide the following functions:

1. Control of exterior lighting dusk to dawn.
2. Dual technology and passive infrared motion sensor lighting controls.

1.4 RELATED WORK ELSEWHERE

A. Division 09: Finishes.

B. Division 11: Equipment

C. Division 26, 27, and 28: Electrical

1.5 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

B. The following information shall be submitted in addition to items listed above:

1. Wiring diagram indicating wire size and type for each individual piece of equipment.

2. Complete riser diagram indicating all equipment and interconnecting components with indication of location of each device.
3. Submittal drawings are required for the following systems. They shall include the following:

    a. Exterior lighting controls:

        1) Wiring diagrams for exterior lighting controls showing front panel elevation, panel wiring schematic, and indication of controlled circuits.
        2) Cut sheets on components.
        3) Diagrams shall include a ladder diagram showing the entire system and all interconnects.

    b. Dual technology, Passive infrared and ultrasonic lighting controls.

        1) Drawing showing all switches, and sensors and connections between all devices and lighting circuits.
        2) Cut sheets on components.
        3) Proper circuit numbers shall be shown on drawings.

1.6 OPERATION & MAINTENANCE MANUALS

A. Submit Operations & Maintenance Manuals in accordance with Section 26 05 04.

1.7 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. All materials, equipment and parts shall be new and unused of current manufacture.

C. Provide all necessary accessories required for a complete and operable system.

1.8 WARRANTY

A. Equipment shall be warranted for a period of not less than 1 year from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials and equipment shall be new (less than 1 year old when turned over to the Owner).

B. Furnish and install complete lighting control system as specified in these specifications and on the drawings. Exact quantities and equipment configurations to be determined by plans, specifications, control schedules, and as required by manufacturer to make a complete and operating system.

2.2 DUAL TECHNOLOGY CEILING MOUNTED LIGHTING CONTROL

A. Provide dual technology type lighting controls in all areas unless directed to use single technology ultrasonic or passive infrared technology.

B. Determine proper sensor type and relay for direct connection requirements. Provide appropriate units.

C. Employ the services of a manufacturer's appointed representative to assist in making the proper adjustments on the motion detector installation. Meet with this person prior to making installation to determine if the locations shown are appropriate for the type of device being furnished. Make modifications in the locations for the devices, if required, to provide a more adequate installation.

D. Modify time settings, sensitivity settings, and "initial on" and "keep on" controls as necessary, and as required for the space. Default time of 15 minutes "keep on" time will be used at initial activation.

E. Installation assistance:

1. Include time in bid to work with the Owner and manufacturer to determine the proper time setting and sensor setting for each of the motion switches.
2. Each of the switches shall be set for the type of space in which they operate.
3. Include time in bid to have the manufacturer's representative come on site and review the job to determine what the expected settings are for the equipment.

F. Zero crossing relay controls shall be supplied.

G. Dual technology occupancy sensors shall be capable of detecting presence in the floor area by detecting doppler shifts in transmitted ultrasound and passive infrared heat changes.

H. Ultrasonic sensing shall be volumetric in coverage.

I. Passive infrared sensing shall utilize a multi-element fresnel lens to ensure that the sensor is insensitive to short-wavelength infrared waves such as those emitted by the sun. Lens shall have grooves facing in to avoid dust and residue build up which affect ir reception.

J. Both technologies shall sense presence in floor area before lighting will turn on. Detection by either technology shall hold lighting on for set period of time.

K. Sensors shall have time-out adjustment from 15 seconds to 35 minutes. Sensor shall not have settings exceeding 35minutes.

L. Sensors shall cover 2000 square feet with standard lens and 90 linear feet with long-range lens for walking motion. Coverage meeting NEMA Standard WD 7-2000 will be required.

M. Sensors shall be capable of being networked to achieve adequate coverage.

N. Sensors shall have an isolated relay rated at 24VDC that can be used to interface with HVAC, EMS, and other monitoring systems.

O. Each sensing technology shall have independent sensitivity adjustments, time adjustments and led display.

P. Sensitivity and timer control shall be accessible on the front of the sensor. Sensor shall incorporate an accessible but recessed on/override device.

Q. Sensors shall operate on 24VDC.

R. Power supply shall be provided by a power pack that consists of a transformer and contact relay in one unit.

S. Provide 18 gauge plenum rated cable for interconnection of centers to relays.

T. Sensor shall have standard 5 year warranty and shall be UL listed.

U. The high bay sensors shown shall be Sensor Switch CM-6 type, or Wattstopper, Hubbell, Novitas, or Leviton equals. Provide low temperature / high humidity option for sensors located in Cold Storage Building.

V. Approved venders are Watt Stopper, Hubbell, Novitas, Leviton, or Sensor Switch.

2.3 AUTOMATIC PASSIVE INFRARED WALL SWITCH LIGHTING CONTROL

A. Where so indicated, provide a passive infrared wall switch lighting control.

B. Determine proper sensor type and relay for direct connection requirements. Provide appropriate units.

C. Employ the services of a manufacturer’s appointed representative to assist in making the proper adjustments on the motion detector installation. Meet with this person prior to making installation to determine if the locations shown are appropriate for the type of device being furnished. Make modifications in the locations for the devices, if required, to provide a more adequate installation.

D. Modify time settings, sensitivity settings, and "initial on" and "keep on" controls as necessary, and as required for the space. Default time of 15 minutes “keep on” time will be used at initial activation.

E. Installation assistance:

1. Include time in bid to work with the Owner and manufacturer to determine the proper time setting and sensor setting for each of the motion switches.
2. Each of the switches shall be set for the type of space in which they operate.
3. Include time in bid to have the manufacturer’s representative come on site and review the job to determine what the expected settings are for the equipment.

F. Confirm compatibility with all ballasts and fans used in conjunction with passive infrared wall switch.

G. Zero crossing relay controls shall be supplied.

H. Switch shall have processing capabilities designed to prevent false offs and false triggers.

I. Single relay and dual relay models shall be available. Dual relay models shall provide zero crossing relay controls only on the primary relay.

J. Load range 25 to 600 watts at 120 volts and 60 to 1200 watts at 277 volts.

K. Coverage area shall be 300 Sq. Ft.

L. Switch shall have option of auto on/off or manual on/auto off operation.

M. Switch shall have led passive infrared sensing indicator.

N. Timer to be set for 15 minutes and switch to be set in manual on/auto off mode at turn on.

O. Approved venders are Watt Stopper, Hubbell, Novitas, Leviton, or Sensor Switch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify equipment is in compliance with approved submittal drawings.

3.2 FIELD MEASUREMENTS (NONE)

3.3 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Maintain original quality and condition of equipment while it is in storage.

3.4 INSTALLATION

A. General:

1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer’s recommendations.
2. Install all fixtures, materials, assemblies and equipment in strict accordance with manufacturer’s recommendations and instructions. Consult manufacturer for all wiring diagrams, schematics, sizes, outlets, etc. before installing.

3. Start of installation shall not begin until areas are broom clean, properly lighted, exterior enclosing walls in place, exterior windows glazed, roof completely installed to prevent weather damage to equipment.

B. Cleaning:

1. Prior to turning the system over to the Owner, the system shall be physically cleaned.
2. All appearance defects shall be carefully and professionally touched up so that the equipment is in “factory new” condition.
3. At the completion of the work, remove from the building and the premises all rubbish and debris resulting from the work.

C. Install products in accordance with manufacturer's instructions.

D. Install devices plumb and level.

E. Install switches with off position down.

F. Labeling:

1. Each panel enclosure shall be labeled as to its function.
2. Each bypass switch and bypass relay shall have engraved labels indicating their functions.

G. Final Testing

1. The completed lighting controls system shall be fully tested in accordance with NFPA by the Contractor in the presence of the Owner’s representative and the Engineer. Upon completion of a successful test, the Contractor shall so certify in writing to the Owner.

3.5 OWNER TRAINING

A. Provide complete operator training for the Owner’s personnel.

B. Provide minimum one hour training on the operation of each system in this section.

C. Owner representative shall specifically be shown how the bypass lighting system operates and how he may bypass each of the lighting circuits by operating the bypass switch as part of the control system.

3.6 SPARE EQUIPMENT

A. Two dual technology motion detectors.

END OF SECTION 260923

SECTION 262413 - LOW VOLTAGE SWITCHBOARDS

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.2 APPLICABLE PUBLICATIONS

A. Conform to requirements of current ANSI/NFPA 70 - National Electric Code.

B. Conform to current National Electrical Manufactures Association (NEMA) Standards.

C. Conform to current Underwriters Laboratories (UL) Specifications and Standards.

D. Conform to current American National Standards Institute (ANSI) standards.

E. Conform to National Electrical Contractors Association (NECA) “Standards of Installation.

F. Conform to FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service.

G. Conform to FS W-F-870 - Fuseholders (For Plug and Enclosed Cartridge Fuses).

H. Product specific standards and requirements are included in Product specifications.

1.3 DESCRIPTION OF WORK

A. Furnish and install a complete factory assembled, metal enclosed service entrance switchboard for control of power from incoming line terminals to outgoing feeder terminals as shown on drawings and as specified herein.

1.4 RELATED WORK ELSEWHERE

A. Division 26, 27, and 28: Electrical

1.5 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04

B. The following information shall be submitted in addition to items listed above:

1. Wiring diagram indicating wire size and type for each individual piece of equipment.

2. Complete riser diagram indicating all equipment and interconnecting components with indication of location of each device.
3. Complete front elevation drawing of equipment rack and exact component layout within rack.
4. All drawings must be in CADD format.

1.6 OPERATION & MAINTENANCE MANUALS

A. Submit Operations & Maintenance Manuals in accordance with Section 26 05 04

1.7 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. All materials, equipment and parts are to be new, undamaged, unused, and of current manufacture.

C. Equipment shall conform to the standards of the following agencies:

1. National Electrical Manufacturers Association NEMA PPB-2, Dead Front Switchboards.

D. Production Tests

1. The following production tests shall be completed on switchboard assembly.

a. Dieletic Test.
b. Mechanical Operation Test.
c. Grounding Tests.
d. Control Wiring Tests.
e. Electrical Operation Tests.

E. The panelboards provided under this section shall be the products of a single manufacturer specializing in manufacture of panelboard products with a minimum of fifty years documented experience.

F. Provide all necessary accessories required for a complete and operable system.

1.8 WARRANTY

A. Equipment shall be warranted for a period of not less than 1 year from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

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.

PART 2 - PRODUCTS

2.1 GENERAL

A. Approved manufacturers:

1. Square D.
2. Cutler Hammer.

B. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials and equipment shall be new (less than 1 year old when turned over to the Owner).

C. Provide a complete and fully functional distribution system using materials and equipment of types, sizes, and rating as required to meet performance requirements. Use materials and equipment that comply with referenced standards and manufacturer's standard design and construction, in accordance with published product information. Coordinate the features of all materials and equipment so they form an integrated system, with components and interconnections matched for optimum performance of specified functions.

2.2 SWITCHBOARD RATINGS

A. Provide bus bracing and short circuit current rating as indicated on drawings.

B. Switchboard shall be fully rated for the short circuit current rating as shown.

C. Series ratings of circuit breakers to achieve the short circuit rating shall not be acceptable.

2.3 SWITCHBOARD CONSTRUCTION

A. Switchboard shall bear Listing Mark in accordance with UL Construction Materials List, (384W4) WEVZ.

B. Enclosure shall be NEMA PB2 Type 1, general purpose, dead-front with front accessibility.

C. Switchboard framework shall be steel channels bolted to the frame to rigidly support the entire shipping section for moving on rollers and floor mounting.

D. Construction shall be of formed, code gauge steel, rigidly welded and bolted together to support all cover plates, bussing and component devices.

E. Switchboard shall be totally enclosed, dead front, freestanding with front only accessibility required.

F. Section(s) shall be open bottom and individually removable top plate for installation and termination of conduit.

G. Finish shall be as follows:

1. Apply phosphatizing treatment to steel surfaces prior to application of paint.
2. Apply minimum of one coat of corrosion-resisting paint to internal surfaces.
3. Paint external surfaces with minimum of one coat of corrosion-resisting paint.
4. Color: Indoor Light Gray No. 61, ANSI Z551.
5. Apply corrosion-protective undercoating to under surfaces.

H. Bus bars:

1. Bus Bars shall have sufficient cross-sectional area to meet UL Standard 891 on temperature rise.
2. All bussing shall be tin plated copper.
3. The through bus shall have an ampacity as indicated on the drawings and shall be braced to have a short circuit current rating as indicated on the drawings.
4. Neutral bus bar shall be of equivalent size of the phase bus bar.
5. Bolted through bus supports, connections and joints with Grade 5 hex head bolts and Belleville washers to shall be provided to minimize maintenance requirements.
6. Line and load terminations suitable for the size, number of conductors material shall be provided.
7. Terminations shall be accessible from front.

2.4 SWITCHBOARD IDENTIFICATION

A. Provide the switchboard with an identification plate mounted at the top of the main section.

B. Nameplate shall include switchboard designation as shown on the plans, and the switchboard voltage, interrupting rating and bus rating.

C. Overcurrent devices in the switchboard shall be identified with plastic nameplates as to the load served.

D. Nameplate shall be located adjacent to the feeder device. Load served shall be the next equipment downstream (panelboard, etc.).

E. Where the load served is a motor the HVAC motor designation or other description (ex. Elevator #1) shall be used in lieu of the motor number on the electrical plans.

F. Spare devices shall be identified as such.

G. Plastic nameplates shall be black with white engraved lettering. Lettering shall be 3/4" high minimum.

H. Provide engraved nameplates for each switchboard and each circuit breaker.

2.5 MAIN SWITCH

A. See one line diagram for type of switch to furnish.

B. Circuit breaker main:

1. Solid-state Molded Case Circuit Breakers: NEMA AB 1, provided with electronic sensing, timing and tripping circuits for adjustable current settings, ground fault trip, instantaneous trip, and adjustable short time trip.
2. Provide stationary mounting.
3. Provide ground fault sensing integral with circuit breaker.
4. Provide digital integral meters for voltage and amperage.
5. Determine proper breaker settings in conjunction with equipment supplier. Set main breaker trip points to coordinate with downstream breakers. Set ground fault trip at 58% of main breaker amps.

2.6 SWITCHING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded Case Circuit Breaker:

1. Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole.
2. Electronic trip molded case standard function 80 percent rated circuit breakers:

    a. All electronic circuit breakers shall have the following time/current response adjustments: Long Time Pickup, Long Time Delay, Short Time Pickup, Short Time Delay, Ground Fault Pickup, Ground Fault Delay, and Instantaneous settings. Each adjustment shall have discrete settings (fully adjustable) and shall be independent of all other adjustments.
    b. Circuit breaker trip system shall be a microprocessor-based true RMS sensing designed with sensing accuracy through the thirteenth (13th) harmonic. Sensor ampere ratings shall be as indicated on the drawings.
    c. Local visual trip indication for overload, short circuit and ground fault trip occurrences
    d. Long Time Pickup indication to signal when loading approaches or exceeds the adjustable ampere rating of the circuit breaker shall be provided.
    e. Provide for all main circuit breakers.
    f. Provide for branch circuit breakers, 250A frame size and above, where indicated on the drawings.

3. Thermal magnetic molded case circuit breakers

    a. Molded case circuit breakers shall have integral thermal and instantaneous magnetic trip in each pole.
    b. Circuit breakers shall be suitable for the interrupting rating indicated on the drawings.
    c. Where true current limiting circuit breakers are indicated on the drawings, manufacturer shall submit one set of published let-through curves (as required by UL) to the owner.
    d. Ampere ratings shall be as shown on the drawings.
    e. Provide for all branch circuit breakers, unless indicated otherwise on the drawings.

2.7 INSTRUMENT AND SENSORS

A. Electronic circuit monitors shall:

1. Provide True rms metered values.
2. Provide information by each circuit monitor that shall include frequency, current, demand current, voltage, real power, reactive power, apparent power, demand power, power factor, accumulated energy, accumulated reactive energy, and total harmonic distortion (THD) of each current and voltage, all updated at the same time.
3. Digitally sample the current and voltage signals at a rate high enough to provide valid data for waveform analysis and true-rms metering accurate beyond the 30th harmonic (fundamental of 60 Hz).

B. All setup parameters required by the circuit monitors shall be stored in nonvolatile memory and retained in the event of a control power interruption.

C. Any battery or other device used to provide non-volatile memory shall be serviceable from the front of the circuit monitor and servicing shall not require removing the circuit monitor from the equipment in which it is mounted.

D. The circuit monitor shall maintain in non-volatile memory, maximum and minimum values for each of the instantaneous values reported as well as the time and date that the minimum or maximum was set.

2.8 DISTRIBUTION SECTIONS

A. Distribution circuit breakers shall

1. Be thermal magnetic molded case group mounted in frames size 100 amps, through 600 amps.
2. Be totally front accessible and mounted in the switchboard to permit installation, maintenance and testing without reaching over any line side bussing.
3. Be removable by the disconnection of only the load side terminations and all line and load side connections are to be individual to each circuit breaker.
4. No common mounting brackets or electrical bus connectors. Common mounting brackets or electrical bus connectors will not be acceptable.
5. Be provided with provisions for locking in the closed position.

B. Each circuit breaker is to be furnished with an externally operable mechanical means to trip the circuit breaker, enabling maintenance personnel to verify the ability of the circuit breaker trip mechanism to operate, as well as exercise the circuit breaker operating mechanisms.

C. Spaces for future circuit breakers shall be provided with the necessary mounting hardware and bus extensions to accommodate their installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify equipment is in compliance with approved submittal drawings.

B. Examine area to receive switchboard to assure adequate clearance for switchboard installation.

C. Check that concrete pads have been installed and are level and free of irregularities.

D. Start work only after unsatisfactory conditions are corrected.

E. Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.

F. Field tests prior to energizing shall be as follows:

1. Continuity.
2. Short circuit.
3. Perform tests according to switchboard manufacturer's instructions.

G. Measure resistance of each bus section phase-to-phase, and phase-to-ground for 1 minute each. Test voltage shall be 1000 volts and minimal acceptable value for installation resistance is to be 2 megohms.

H. Adjust operating mechanisms for free mechanical movement.

I. Tighten bus connections and mechanical fasteners.

J. Touch-up scratched or marred surfaces to match original finish.

K. Determine appropriate breaker and ground fault settings.

3.2 FIELD MEASUREMENTS

A. Field verify locations of low voltage switchboards with other trades. Adjust as required to meet field conditions and code requirements.

B. Identify conflicts with the work of other trades prior to installation of electrical equipment.

C. Adjust switchboard installation to satisfy field requirements.

3.3 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Lift using manufacturer supplied attachments.

C. Do not store exposed to weather.

D. Physically protect against damage from work of other trades.

3.4 INSTALLATION

A. General:

1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer's recommendations.
2. Install all materials, assemblies and equipment in strict accordance with manufacturer's recommendations and instructions. Consult manufacturer for all wiring diagrams, schematics, sizes, outlets, etc. before installing.
3. Start of installation shall not begin until areas are broom clean, properly lighted, exterior enclosing walls in place, exterior windows glazed, roof completely installed to prevent weather damage to equipment.

B. Cleaning:

1. Prior to turning the system over to the Owner, the system shall be physically cleaned.
2. All appearance defects shall be carefully and professionally touched up so that the equipment is in "factory new" condition.
3. At the completion of the work, remove from the building and the premises all rubbish and debris resulting from the work.

C. Grounding:

1. All equipment shall be grounded in accordance with NEC, these specifications and drawings, and the equipment supplier's recommendations.

D. Install switchboard in accordance with manufacturer's written instructions and NEC.

E. Provide 4" high concrete housekeeping pad, 4" larger around the footprint of switchboard.

F. Provide provisions for future distribution sections as indicated on drawings.

3.5 OWNER TRAINING

A. Provide minimum one hour training on the operation of each system in this section.

B. Owner representative shall be instructed on system troubleshooting and resetting procedure.

3.6 SPARE EQUIPMENT

A. As shown on schedules.

B. All spare breakers listed on panel schedules to be mounted in switchboards.

END OF SECTION 262413

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.2 APPLICABLE PUBLICATIONS

A. American National Standards Institute/National Fire Protection Agency (ANSI/NFPA), Specifications and Standards, current edition:

1. NFPA70 – National Electrical Code.

B. National Electrical Contractors Association (NECA), Standard of Installation, current edition.

C. National Electrical Manufacturers Association (NEMA), Specifications and Standards, current edition.

1. NEMA PB 1 - Panelboards
2. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
3. NEMA AB 1 - Molded Case Circuit Breakers.
4. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)

D. Underwriters Laboratories, Inc. (UL), Specifications and Standards, current edition:

1. UL 50 - Enclosures for Electrical Equipment
2. UL 67 - Panelboards.
3. UL 98 - Enclosed and Dead-front Switches
4. UL 489 - Molded-Case Circuit Breakers and Circuit Breaker Enclosures

E. Canadian Standards Association (CSA), Specifications and Standards, current edition:

1. CSA Standard C22.2 No. 29-M1989 - Panelboards and Enclosed Panelboards
2. CSA Standard C22.2 No. 5-M91 - Molded Case Circuit Breakers

F. Federal Specifications and standards, current edition:

1. W-P-115C - Type I Class 1
2. W-C-375B - Molded Case Circuit Breakers
3. W-C-375B/Gen - Circuit Breakers, Molded Case, Branch Circuit and Service.
4. W-P115C - Type 1 Class 2 Load Center

G. American Society of Testing Materials (ASTM), Specifications and Standards, current edition.

1.3 DESCRIPTION OF WORK

A. Furnish and install complete and operable Distribution and Branch Circuit Panelboards system as indicated on the drawings and as specified herein.

1.4 RELATED WORK ELSEWHERE

A. Division 26, 27, and 28: Electrical

1.5 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

B. The following information shall be submitted in addition to the above:

1. Manufacturer literature sufficient in scope to demonstrate compliance with the requirements of this specification.
2. Overall panelboard dimensions, interior mounting dimensions, and wiring gutter dimensions. The location of the main, branches, and solid neutral shall be clearly shown. Illustrate one line diagrams with applicable voltage systems.

1.6 OPERATION & MAINTENANCE MANUALS

A. Submit Operations & Maintenance Manuals in accordance with Section 26 05 04.

1.7 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. The panelboard manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

C. All panelboards provided under this section shall be the products of a single manufacturer specializing in manufacture of panelboard products with a minimum of fifty years documented experience.

D. Provide all necessary accessories required for a complete and operable system.

1.8 WARRANTY

A. Panelboards shall be warranted for a period of not less than 1 year from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

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.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials and equipment shall be new (less than 1 year old when turned over to the Owner).

B. Provide a complete and fully functional distribution system using materials and equipment of types, sizes, and rating as required to meet performance requirements. Use materials and equipment that comply with referenced standards and manufacturer's standard design and construction, in accordance with published product information. Coordinate the features of all materials and equipment so they form an integrated system, with components and interconnections matched for optimum performance of specified functions.

2.2 240VAC BRANCH CIRCUIT PANELBOARDS

A. Manufacturers

1. Square D Company NQ – Class 1640
2. Cutler-Hammer

B. Interior:

1. Rated for 240 vac/48 VDC maximum. Continuous main current ratings, as indicated on the drawings, not to exceed 600 amperes maximum.
2. UL Listed short circuit current ratings as indicated on the drawings with a maximum of 200,000 RMS symmetrical amperes.
3. Provide one continuous bus bar per phase. Each bus bar shall have sequentially phased branch circuit connectors suitable for plug-on or bolt-on branch circuit breakers. The bussing shall be fully rated. Panelboard bus current ratings shall be determined by heat-rise tests conducted in accordance with UL 67. Bussing shall be plated copper. Bus bar plating shall run the entire length of the bus bar. Main lug and main breaker panelboards shall be suitable for use as Service Equipment.
4. All current-carrying parts shall be insulated from ground and phase-to-phase by high dielectric strength thermoplastic.
5. A solidly bonded copper equipment ground bar shall be provided. An additional copper isolated/insulated ground bar shall also be provided where indicated on the drawings.
6. Split solid neutral shall be plated and located in the mains compartment up to 225 amperes so all incoming neutral cable may be of the same length. UL Listed panelboards with 200 percent rated solid neutrals shall have plated copper neutral bus for non-linear load applications where indicated on the drawings.
7. Interior trim shall be of dead-front construction to shield user from energized parts. Dead-front trim shall have pre-formed twist-outs covering unused mounting space.

8. Nameplates shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, UL Listed label and short circuit current rating shall be displayed on the interior or in a booklet format.
9. Interiors shall be field convertible for top or bottom incoming feed. Main circuit breakers shall be vertically mounted. Sub-feed circuit breakers shall be vertically mounted. Interior leveling provisions shall be provided for flush mounted applications.

C. Main Circuit Breaker:

1. Main circuit breakers shall have an overcenter, trip-free, toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have a permanent trip unit with thermal and magnetic trip elements in each pole. Each thermal element shall be true rms sensing and be factory calibrated to operate in a 40 degrees C ambient environment. Thermal elements shall be ambient compensating above 40 degrees C.
2. Two- and three-pole circuit breakers shall have common tripping of all poles. Circuit breakers frame sizes above 100 amperes shall have a single magnetic trip adjustment located on the front of the circuit breaker that allows the user to simultaneously select the desired trip level of all poles. Circuit breakers shall have a push-to-trip button for maintenance and testing purposes.
3. Circuit breaker handle and faceplate shall indicate rated ampacity. Circuit breakers shall be UL Listed for reverse connection without restrictive line or load markings.
4. Circuit breaker escutcheon shall have international I/O markings, in addition to standard ON/OFF markings. Circuit breaker handle accessories shall provide provisions for locking handle in the ON or OFF position where indicated on the drawings.
5. Lugs shall be UL Listed to accept solid or stranded copper and aluminum conductors. Lugs shall be suitable for 75 degree C rated wire or 90 degree C rated wire as required by the application. Lug body shall be bolted in place; snap-in designs are not acceptable.
6. The circuit breakers shall be UL Listed for use with and provided with the following accessories where indicated on the drawings: Shunt Trip, Under Voltage Trip, Ground Fault Shunt Trip, Auxiliary Switch, Alarm Switch, Mechanical Lug Kits, and Compression Lug Kits.

D. Branch Circuit Breakers:

1. Circuit breakers shall be UL Listed with amperage ratings, interrupting ratings, and number of poles as indicated on the drawings.
2. Molded case branch circuit breakers shall have bolt-on type bus connectors.
3. Circuit breakers shall have an overcenter toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have thermal and magnetic trip elements in each pole. Two- and three-pole circuit breakers shall have common tripping of all poles.
4. There shall be two forms of visible trip indication. The breaker handle shall reside in a position between ON and OFF. In addition, there shall be a red indicator appearing in the clear window of the circuit breaker housing.
5. The exposed faceplates of all branch circuit breakers shall be flush with one another.
6. Lugs shall be UL Listed to accept solid or stranded copper and aluminum conductors. Lugs shall be suitable for 75 degree C rated wire or 90 degree C rated wire as required by the application.
7. Breakers shall be UL Listed for use with the following accessories where indicated on the drawings: Shunt Trip, Auxiliary Switch, and Alarm Switch.

E. Enclosures:

1. Type 1:

a. Boxes shall be galvanized steel constructed in accordance with UL 50 requirements. Galvannealed steel will not be acceptable.
b. Boxes shall have removable endwalls with knockouts located on one end. Boxes shall have welded interior mounting studs. Interior mounting brackets are not required.
c. Box width shall be 26-inch wide maximum.
d. Type 1 Fronts:

1) Front shall meet strength and rigidity requirements per UL 50 standards. Front shall have ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
2) Fronts shall be hinged 1-piece with door. Mounting shall be flush or surface as indicated on the drawings.
3) Panelboards shall have fronts with concealed door hinges and mounted with trim screws. Front shall not be removable with the door locked. Doors on front shall have rounded corners and edges shall be free of burrs.
4) Front shall have cylindrical tumbler type lock with catch and spring-loaded stainless steel door pull. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock. A clear plastic directory cardholder shall be mounted on the inside of door.

PART 3 - EXECUTION

1.1 EXAMINATION

A. Verify equipment is in compliance with approved submittal drawings.

B. Examine area to receive panelboard to assure adequate clearance for panelboard installation.

C. Start work only after unsatisfactory conditions are corrected.

D. Inspect completed installation for physical damage, anchorage, and grounding.

E. Perform tests according to panelboard manufacturer’s instructions.

F. Tighten bus connections and mechanical fasteners.

G. Touch-up scratched or marred surfaces to match original finish.

3.2 FIELD MEASUREMENTS

A. Field verify locations of panelboards with other trades. Adjust as required to meet field conditions and code requirements. Do not base exact panelboard locations on the contract drawings.

B. Identify conflicts with the work of other trades prior to installation of electrical equipment.

C. Adjust panelboard installation to satisfy field requirements.

1.2 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Do not store exposed to weather.

C. Physically protect against damage from work of other trades.

3.3 INSTALLATION

A. General:

1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer’s recommendations.
2. Start of installation shall not begin until areas are broom clean, properly lighted, exterior enclosing walls in place, exterior windows glazed, roof completely installed to prevent weather damage to equipment.

B. Cleaning:

1. Prior to turning the system over to the Owner, the system shall be physically cleaned.
2. All appearance defects shall be carefully and professionally touched up so that the equipment is in “factory new” condition.
3. At the completion of the work, remove from the building and the premises all rubbish and debris resulting from the work.

C. Grounding

1. All equipment shall be grounded in accordance with NEC, these specifications and drawings, and the equipment supplier’s recommendations.

D. Install panelboards so that circuit breakers are not more than 6 feet above the finished floor or grade.

E. Where panelboards or auxiliary cabinets are flush mounted in an outside wall, insulate the enclosure back and sides with 1/2 inch rigid fiberglass insulation and vapor barrier.

F. Selectively connect branch circuits to equally balance currents in the panelboard busses.

G. For each emergency panelboard, provide an engraved red nameplate with white lettering that indicates the following:

1. "This electrical device is being fed from more than one location. Prior to servicing, all sources of power to this panel shall be disconnected."
2. This label shall comply with the requirements stated in specification section 26 05 53.

H. See Section 26 05 29 for equipment mounting.

I. Install panelboards plumb and flush with wall finishes.

J. Install panelboards such that top of panel is located at an elevation of 6-feet above finished floor elevation.

K. Provide filler plates for unused spaces in panelboards.

L. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads. See Section 26 05 53.

M. Stub five empty 1-inch conduits to accessible location above ceiling and additional five empty 1-inch conduits below floor (if space exists) of each flush-mounted panelboard to allow for future expansion.

N. Measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 10 percent, rearrange circuits in the panelboard to balance the phase loads within 10 percent. Take care to maintain proper phasing for multi wire branch circuits.

O. Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

P. Verify that bonding jumper is properly installed in service entrance rated panels.

Q. Thoroughly clean and remove construction debris from panelboard interior and exterior.

3.4 OWNER TRAINING

A. Provide complete operator training for the Owner’s personnel.

B. Use submitted Operations & Maintenance manuals as reference during this demonstration and tour.

3.5 SPARE EQUIPMENT

A. As shown on panel schedules.

B. All spare breakers listed on panel schedules to be mounted in panelboards.

END OF SECTION 262416

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SECTION 262702 - MOTOR WIRING

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.2 APPLICABLE PUBLICATIONS

A. Conform to requirements of current ANSI/NFPA 70 - National Electric Code.

B. Conform to current National Electrical Manufactures Association (NEMA) Standards.

C. Conform to current Underwriters Laboratories (UL) Specifications and Standards.

D. Conform to National Electrical Contractors Association (NECA) “Standards of Installation”.

1.3 DESCRIPTION OF WORK

A. Furnish and install complete connections and wiring to motors as indicated on the drawings and as specified herein.

B. Check the drawings and specifications of all other divisions of work for equipment and work which must be included whether or not shown on the electrical drawings, in order to provide a complete electrical installation.

C. Install all motor starters and variable frequency drives.

D. Coordinate motor installation with other divisions of work.

E. Furnish overload devices for motor starters.

1.4 RELATED WORK ELSEWHERE

A. Division 23 – Heating, Ventilation and Air Conditioning

B. Division 26, 27, and 28 – Electrical.

1.5 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

1.6 OPERATION & MAINTENANCE MANUALS

A. Submit Operations & Maintenance Manuals in accordance with Section 26 05 04.

1.7 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. All materials, equipment and parts are to be new, undamaged and unused of current Manufacture.

1.8 WARRANTY

A. Installation shall be warranted for a period of not less than 1 year from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

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.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that equipment is in compliance with approved submittal drawings.

3.2 FIELD MEASUREMENTS (NONE)

3.3 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Maintain original quality and condition of equipment while it is in storage.

3.4 INSTALLATION

A. General:

1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer's recommendations.
2. Install all materials, assemblies and equipment in strict accordance with manufacturer's recommendations and instructions. Consult manufacturer for all wiring diagrams, schematics, sizes, outlets, etc. before installing.

B. Motor starters shall be furnished by the division of work supplying the motor requiring a starter except where specifically stated otherwise on the electrical drawings.

C. Check the drawings and specifications of the other divisions to determine the requirements for motor disconnect switches and disconnects furnished by other divisions.

1. Install all required disconnect switches.
2. Provide all code required disconnect switches not specifically supplied by others.

D. Unless otherwise indicated on the drawings or elsewhere in these specifications, all motors shall be furnished by others.

E. Motors shall be set in place by others and the associated motor starters, controllers, and disconnects shall be turned over for installation.

F. Control wiring, regardless of voltage, shall be the responsibility of the division providing the motor unless specifically indicated otherwise on the electrical drawings.

G. Furnish and size the overload protection as required for the motor load.

1. Thoroughly investigate the equipment connection schedules and other portions of the contract drawings to determine the extent of work required for connections to equipment furnished by others.

H. The National Electric code requires that a duplex receptacle be installed on the roof anytime there is roof mounted equipment installed:

1. Provide a heavy-duty weatherproof ground fault receptacle on the roof near the roof mounted air conditioning, refrigeration, and heating equipment.
2. The outlet box shall be an FS cast iron type.
3. This receptacle may be attached to an equipment supporting leg or other similar apparatus on the roof, or if none is available, shall be supported using a supporting framework.
4. The receptacle feed conduits shall be stubbed through the roof using a weatherproof boot.
5. This receptacle shall be connected to the nearest available panel and connected to a 20 amp circuit breaker unless shown otherwise on plans.
6. This receptacle shall be furnished whether or not it is explicitly shown on the drawings.

I. Provide duct smoke detectors where called out on the plans:

1. Coordinate the installation of the duct detectors with Division 23.

2. The duct detectors are connected to shut down the air handling unit.
3. Work with Division 23 to be certain that the proper interface connections are provided in the temperature control panel or the air handler starter, to make the connection for the shut down.
4. Mark the temperature control panel or the roof top unit starter with a permanently engraved label that states: "This unit is connected to automatically shut down with fire alarm system."

J. Final Testing:

1. Prior to energizing any equipment whether installed by this section or not:
2. First make a thorough inspection of it to make sure it has been unpacked correctly and all packing materials and supports have been removed.
3. Be responsible for assisting the equipment start up personnel to assure correct equipment connections and rotation.

3.5 OWNER TRAINING (NONE)

3.6 SPARE EQUIPMENT (NONE)

END OF SECTION 262702

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.2 APPLICABLE PUBLICATIONS

A. Conform to requirements of ANSI/NFPA 70 - National Electric Code.

B. Conform to current Underwriters Laboratories (UL) Specifications and Standards.

C. Device specific standards and requirements are included in device specifications.

1.3 DESCRIPTION OF WORK

A. Provide and install wiring devices as required on the drawings and as specified herein.

1.4 RELATED WORK ELSEWHERE

A. Division 09: Finishes.

B. Division 11: Equipment

C. Division 26, 27, and 28: Electrical

1.5 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

B. The following information shall be submitted in addition to items listed above:

1. One sample of each switch will be supplied to Electrical Engineer, for review prior to installation.
2. One sample of each receptacle will be supplied to Electrical Engineer for review prior to installation

1.6 OPERATION & MAINTENANCE MANUALS

A. Submit Operations & Maintenance Manuals in accordance with Section 26 05 04.

1.7 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. All materials, equipment and parts shall be new and unused of current manufacture.

C. Provide all necessary accessories required for a complete and operable system.

D. Store wiring devices and accessories in original cartons and in clean dry space; protect from weather and construction traffic.

1.8 WARRANTY

A. Equipment shall be warranted for a period of not less than 1 year from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

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.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials and equipment shall be new (less than 1 year old when turned over to the Owner).

2.2 WALL SWITCHES

A. Switches shall be:

1. UL listed for current and voltages indicated.
2. Shall comply with NEMA standard publication WD-1, “Heavy Duty Wiring Devices”.
3. Federal Specifications Test WS-896 E.
4. UL standard 20, 943 class A (GFCI) and 498.

B. Switches shall be 20 ampere heavy duty specification grade unless noted.

C. Switches shall have provisions for back and side wiring, screw clamp type suitable for solid or stranded wire with separate green ground screw.

D. Switches shall be white unless noted.

E. Switches shall be made of nylon or high impact resistant material.

F. Modular switches with pigtailed terminals are allowed.

G. Supply the following:

1. Wall switch with:

a. 20 ampere, 120/277 volt rating.
b. Toggle handle.
c. Single-pole, double-pole, 3-way and 4-way switches shall be available.
d. Approved vendors are: Cooper, Hubbell Wiring, Leviton, and Pass & Seymour.

2. Dimmer Switch to control 0-10V LED drivers with:

a. Single-pole and 3-way
b. Slide dimmer
c. Push button on/off preset
d. 1,200VA 120/277 Volt AC, 60Hz
e. No LED indicator light.
f. Compatible with 0-10VDC LED power supplies.
g. Leviton IP710-LFZ or equal, color to match switches.

3. Locked (keyed) wall switch with:

a. 20 ampere, 120/277 volt rating.
b. Key handle shall be removable in on or off position.
c. One key shall be supplied with each switch.
d. Single-pole, 3-way and 4-way switches shall be available.
e. Approved vendors are: Cooper, Hubbell Wiring, Leviton, and Pass & Seymour.

2.3 RECEPTACLES

A. Receptacles shall be:

1. UL listed for current, uses and voltages indicated.
2. Tamper resistant.
3. Shall comply with NEMA standard publication WD-1 and WD-6 standards.

B. Receptacles shall be specification grade unless noted.

C. Receptacles (with the exception of GFCI) shall have one piece brass strap.

D. Receptacles shall have provisions for back and side wiring, screw clamp type suitable for solid or stranded wire with separate green ground screw.

E. Receptacles shall be white unless noted.

F. Modular receptacles with pigtailed terminals are allowed.

G. Receptacles shall be made of nylon or high impact resistant material.

H. Receptacles installed in wet or damp locations shall be weather resistant.

I. Receptacles shall be supplied with face plate.

J. Supply the following:

1. Tamper Resistant Duplex NEMA 5-20R heavy duty straight blade receptacles with:

    a. 20 ampere, 120 volt rating.
    b. Standard face shape.
    c. 2-pole, 3-wire grounding
    d. Approved vendors are: Cooper, Hubbell Wiring, Leviton, and Pass & Seymour.

2. Tamper Resistant GFI Weather Resistant Duplex NEMA 5-20R

    a. 20 ampere, 120 volt rating
    b. Standard GFCI face.
    c. GFCI compatible face plate.
    d. 2-pole, 3-wire grounding
    e. Weather Resistant Construction
    f. Approved vendors: Cooper, Hubbell Wiring, Leviton, and Pass & Seymour

3. Tamper Resistant GFCI Duplex NEMA 5-20R receptacles with:

    a. 20 ampere, 125 volt rating.
    b. Standard GFCI face.
    c. GFCI compatible face plate.
    d. 2-pole, 3-wire grounding.
    e. Approved vendors are: Cooper, Hubbell Wiring, Leviton, Pass & Seymour.

4. Tamper Resistant USB Duplex NEMA 5-20R heavy duty straight blade receptacles with:

    a. 5.1A Two USB Type-A/Type-C
    b. Duplex NEMA 5-20R outlets
    c. 20 ampere, 120 volt rating.
    d. Decora compatible face plate.
    e. 2-pole, 3-wire grounding
    f. Approved vendors are: Cooper, Hubbell Wiring, Leviton, and Pass & Seymour.

5. Surge protected (Tamper Resistant) NEMA 5-20R receptacle with:

    a. 20 ampere, 125 volt rating.
    b. Damage alert alarm.
    c. Damage alert alarm muting screw.
    d. Indicator light.
    e. Minimum 210 joules/13000A surge protection.
    f. 2-pole, 3-wire grounding.
    g. Approved vendors are: Cooper, Hubbell Wiring, Leviton, and Pass & Seymour.

6. Heavy duty flush single straight blade receptacle with:

    a. Standard face shape.
    b. NEMA 5-15R (Tamper Resistant)

1) 15 ampere, 125 volt rating.
2) 2-pole, 3-wire grounding.

c. NEMA 5-20R (Tamper Resistant)

1) 20 ampere, 125 volt rating.
2) 2-pole, 3-wire grounding.

d. NEMA 14-30R (Tamper Resistant)

1) 30Ampere, 125/250 volt rating.
2) 3-pole, 4-wire grounding.
3) Glass reinforced

e. NEMA 14-50R

1) 50 ampere, 125/250 volt rating.
2) 3-pole, 4-wire grounding.
3) Glass reinforced.

f. NEMA14-60R

1) 60 ampere, 125/250 volt rating.
2) 3-pole, 4-wire grounding.
3) Glass reinforced.

g. Approved vendors are: Cooper, Hubbell Wiring, Leviton, and Pass & Seymour.

7. Flush single twist-lock receptacle with:

a. Standard face shape.
b. NEMA L6-15R

1) 15 ampere, 250 volt rating.
2) 2-pole, 3-wire grounding.

c. NEMA L7-15R

1) 15 ampere, 277 volt AC rating.
2) 2-pole, 3-wire grounding.

d. NEMA L6-20R

1) 20 ampere, 250 volt rating.
2) 2-pole, 3-wire grounding.

e. NEMA L7-20R

1) 20 ampere, 277 volt AC rating.
2) 2-pole, 3-wire grounding.

f. NEMA L15-20R

1) 20 ampere, 250 volt AC rating.
2) 3-pole, 4-wire grounding.

g. Approved vendors are: Cooper, Hubbell Wiring, Leviton, and Pass & Seymour.

2.4 PLATE COVERS

A. All plate covers shall be white lexan covers in office area and stainless steel in all other areas.

B. Cast metal plates: Die cast profile, ribbed for strength, flash removed, primed with gray enamel, furnished complete with four mounting screws.

C. Steel plates: Hot dip galvanized, 1.25 oz/sq. ft. minimum.

D. Weatherproof receptacle plate shall be heavy duty type, cast aluminum with a deep cover hood to provide weatherproof protection while an attachment plug cap is inserted. Plate shall be code approved as "suitable for wet locations while in use". Weatherproof cover shall be provided with ¼"padlock hole. Plate must meet OSHA lockout/tagout requirements. Provide a padlock for each weatherproof receptacle cover installed on the project. All padlocks shall be keyed alike. Provide twenty spare keys for Owner's use.

E. Surface box plates: Beveled, steel, pressure formed for smooth edge to fit box.

F. Where two-gang boxes are required for single gang devices, provide special plates with device opening in one gang and second gang blank.

G. Approved vendors are: Cooper, Hubbell Wiring, Leviton, and Pass & Seymour.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Verify outlet boxes are installed at proper height.

B. Verify wall openings are neatly cut and will be completely covered by wall plates.

C. Verify floor boxes are adjusted properly, plumb and level.

D. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

E. Inspect each wiring device for defects.

F. Operate each wall switch with circuit energized and verify proper operation.

G. Verify that each receptacle device is energized.

H. Test each receptacle device for proper polarity.

I. Test each GFCI receptacle device for proper operation.

J. Test that each receptacle is properly grounded.

K. Adjust devices and wall plates to be flush and level.

3.2 FIELD MEASUREMENTS

A. Field verify proper location of all wiring devices with field conditions and adjust accordingly.

3.3 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Maintain original quality and condition of equipment while it is in storage.

3.4 INSTALLATION

A. General:

1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer’s recommendations.
2. Install all materials, assemblies and equipment in strict accordance with manufacturer’s recommendations and instructions. Consult manufacturer for all wiring diagrams, schematics, sizes, outlets, etc. before installing.
3. Start of installation shall not begin until areas are broom clean, properly lighted, exterior enclosing walls in place, exterior windows glazed, roof completely installed to prevent weather damage to equipment.

B. Install products in accordance with manufacturer's instructions.

C. Install devices plumb and level.

D. Install switches with OFF position down.

E. Install vertical receptacles with grounding pole on top and horizontal receptacles with grounding pole to left.

F. Connect wiring device grounding terminal to outlet box with bonding jumper.

G. Install decorative plates on switch, receptacle, and blank outlets in finished areas.

H. Connect wiring devices by wrapping solid conductor around screw terminal or inserting into wire clamp. Wrapping conductor not allowed for stranded wire.

I. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

J. Mount switches at heights shown in specification 26 05 37 unless otherwise noted. Coordinate location with architectural detail.

K. In areas where ceiling mounted receptacles and outlets are shown, the face of the receptacle or outlet is to be flush with the ceiling finish. For grid ceilings, provide proper support framing such that receptacles and outlets can be used from the ceiling below without damaging the ceiling tile.

L. Preparation:

1. Provide extension rings to bring outlet boxes flush with finished surface.
2. Clean debris from outlet boxes.

3.5 OWNER TRAINING (NONE)

3.6 SPARE EQUIPMENT

A. Provide ten duplex receptacles.

B. Provide twelve light switches.

END OF SECTION 262726

SECTION 262728 - CIRCUIT & MOTOR DISCONNECTS

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.2 APPLICABLE PUBLICATIONS

A. Conform to requirements of current ANSI/NFPA 70 - National Electric Code.

B. Conform to current National Electrical Manufactures Association (NEMA) Standards.

C. Conform to current Underwriters Laboratories (UL) Specifications and Standards.

1.3 DESCRIPTION OF WORK

A. Furnish and install heavy-duty fusible type disconnect switches of types scheduled at locations shown on the drawings and as specified herein.

B. Furnish and install other disconnect switches as necessary and required with proper number of poles, voltage and enclosure type ratings as required for the application and as required by the National Electrical Code.

C. The drawings may or may not indicate disconnects. Disconnects shown on drawings shall be installed for that piece of equipment, even if the disconnect is not required by code.

D. Provide proper environmental enclosure for disconnect depending on the mounting location.

E. Provide fused or non-fused disconnect as required for proper protection of the equipment.

F. Provide all code required disconnects. Assume responsibility for reviewing equipment connections and starting equipment provided with the equipment and determining if disconnects are required.

G. For fused disconnects, provide appropriately sized fuses for the equipment.

H. Install and wire mechanical system starters. See other portions of specifications indicating requirements for work.

1.4 RELATED WORK ELSEWHERE

A. Division 23: Heating, Ventilation and Air Conditioning

B. Division 26, 27, and 28: Electrical

1.5 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

1.6 OPERATION & MAINTENANCE MANUALS

A. Submit Operations & Maintenance Manuals in accordance with Section 26 05 04.

1.7 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. All materials, equipment and parts are to be new, undamaged and unused of current Manufacture.

1.8 WARRANTY

A. Equipment shall be warranted for a period of not less than 1 year from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

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.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials and equipment shall be new (less than 1 year old when turned over to the Owner).

2.2 DISCONNECTS

A. Disconnect switches shall be heavy duty switch operated type with cover interlock and enclosed arc chamber, quick make and quick break and provision for padlocking in either the open or closed position. All heavy duty, safety switches 30 to 600A, shall be provided with Class R rejection style fuse clips. The combination rating of the heavy-duty switch and R fuse shall be 200,000 symmetrical amps and labeled as such.

B. Approved manufacturers: Square D, Cutler Hammer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify equipment is in compliance with approved submittal drawings.

3.2 FIELD MEASUREMENTS

A. Field verify locations of disconnects with other trades. Adjust as required to meet field conditions and code requirements.

3.3 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Maintain original quality and condition of equipment while it is in storage.

3.4 INSTALLATION

A. General:

1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer's recommendations.
2. Install all materials, assemblies and equipment in strict accordance with manufacturer's recommendations and instructions. Consult manufacturer for all wiring diagrams, schematics, sizes, outlets, etc. before installing.
3. Mount per Section 26 05 29.

B. Cleaning:

1. Prior to turning the system over to the Owner, the system shall be physically cleaned.
2. All appearance defects shall be carefully and professionally touched up so that the equipment is in "factory new" condition.
3. At the completion of the work, remove from the building and the premises all rubbish and debris resulting from the work.

C. Motor and Equipment Connections

1. Check HVAC motor schedule to ascertain if disconnect is required at motor. If disconnect is not shown on drawing and the NEC requires a disconnect, it shall be furnished and installed by this Division 26.
2. The location of motors and motor equipment shown on plans including disconnect switches and starters are approximate unless otherwise specified. Obtain the exact locations from the Architect or from Division furnishing the equipment.

3. Other contractors will furnish combination starters for installation. Refer to the HVAC drawings to determine starter locations. If starter locations are not indicated, determine best starter location on site.
4. Where a VFD or combination starter is indicated on the HVAC motor starter schedule and has a disconnect as part of it, a separate disconnect shall not be required.
5. HVAC temperature control connections will be done by the HVAC temperature control contractor.

3.5 OWNER TRAINING

A. Provide one hour minimum training on operation and trouble shooting each system in this section.

3.6 SPARE EQUIPMENT

A. Provide one set of spare fuses for each fusible disconnect provided.

END OF SECTION 262728

SECTION 263200 - STANDBY ENGINE/GENERATOR SET

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.2 APPLICABLE PUBLICATIONS

A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent applicable.

1. American National Standards Institute/National Fire Protection Agency (ANSI/NFPA), Specifications and Standards, current edition:

    a. NFPA70 – National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
    b. NFPA99 – Essential Electrical Systems for Health Care Facilities.
    c. NFPA110 – Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1-prototype tests required by this standard shall be performed on a complete and functional unit; component level type tests will not substitute for this requirement.

2. Canadian Standards Association (CSA), Specifications and Standards, current edition:

    a. CSA C22.2, No. 14 – M91 Industrial Control Equipment.
    b. CSA 282, 1989 Emergency Electrical Power Supply for Buildings.

3. International Electrotechnical Commission (IEC), Specifications and Standards, current edition:

    a. IEC8528 part 4. Control Systems for Generator Sets.

4. Institute of Electrical and Electronics Engineers, Specifications and Standards, current edition:

    a. IEEE446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.

5. National Electrical Manufacturers Association (NEMA), Specifications and Standards, current edition:

    a. NEMA ICS10-1993 – AC Generator sets.

6. Underwriters Laboratories, Inc. (UL), Specifications and Standards, current edition:

a. UL2200. The genset shall be listed to UL2200 or submit to an independent third party certification process to verify compliance as installed.

7. Environmental Protection Agency (EPA) Spark Ignited (SI) New Source Performance Standards (NSPS):

a. The generator shall be manufacturer certified to meet current emission standards.

1.3 DESCRIPTION OF WORK

A. Furnish and install complete factory assembled generator set equipment with standard analog controls as indicated on the drawings and as specified herein.

B. Provide factory test, startup by a supplier authorized by the manufacturer, and on-site testing of the system.

C. The generator set manufacturer shall warrant all equipment provided under this section, whether or not is manufactured by the generator set manufacturer, so that there is one source for warranty and product service. Technicians specifically trained and certified by the manufacturer to support the product and employed by the generator set supplier shall service the generator sets.

1.4 RELATED WORK ELSEWHERE

A. For the purpose of obtaining a complete and integrated standby power system, the following sections shall be included under the scope of this section:

1. Section 26 32 38 – Generator Connection Box
2. Section 26 36 00 – Transfer Switch

B. The following sections include work which is related to the Standby Engine/Generator Set, but which is not included under the scope of this section:

1. Division 23 – Heating, Ventilation and Air Conditioning.
2. Division 26, 27, and 28 – Electrical.

1.5 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

B. The following information shall be submitted in addition to items listed above:

1. Wiring diagrams indicating wire size and type for each individual piece of equipment.
2. Complete diagrams indicating all equipment and interconnecting components with indication of location of each device.
3. Complete plan, side and elevation view drawings of skid-mounted equipment and exact component layout.
4. All drawings must be in CADD format.
5. Manufacturer certification of prototype testing.

6. Manufacturers published warranty documents.
7. Plan and elevation views with certified overall dimensions, as well as wiring interconnection details.
8. Interconnection wiring diagrams showing all external connections required with field wiring terminals marked in a consistent point-to-point manner.
9. Manufacturer's installation instructions.

1.6 OPERATION & MAINTENANCE MANUALS

A. Submit Operations & Maintenance Manuals in accordance with Section 26 05 04.

1.7 FACTORY TESTING

A. The generator set supplier shall perform a complete operational test on the generator set prior to shipping from the factory. Provide a certified test report. Fully test supplied equipment at the factory for function and performance.

B. Factory testing may be witnessed by the Owner and Consulting Engineer. Costs for travel expenses will be the responsibility of the Owner and Consulting Engineer. Supplier is responsible to provide two weeks notice for testing.

C. Perform generator set factory tests on the equipment at rated load and rated power factor. Generator sets that have not been factory tested at rated power factor will not be acceptable. Tests shall include: run at full load, maximum power, voltage regulation, transient and steady-state governing, single step load pickup, and function of safety shutdowns.

1.8 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. The following shall be provided in addition to items listed above.

1. Arrange pre-installation meeting.
2. Factory Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer’s products that are similar in material, design, and extent to those indicated for this Project.
3. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
4. Manufacturer’s Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.
5. Manufacturer must carry replacement parts.

C. The generator set manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

D. All materials, equipment, and parts shall be new and unused of current manufacture.

E. System supplier shall be responsible for providing all necessary accessories required for a complete and operable system.

F. The Standby Engine/Generator Set manufacturer shall have been engaged in the manufacture of generator sets for a minimum of ten years and shall have a factory trained service and parts organization located within 100 miles of the jobsite.

G. All control equipment shall be the standard product of the engine/generator set manufacturer. Controls systems supplied by a subcontractor of the manufacturer and not incorporated into the standard documentation of the manufacturer will not be acceptable.

1.9 WARRANTY

A. The generator set and associated equipment shall be warranted for a period of not less than 5 years from the date of commissioning against defects in materials and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

C. The manufacturer of the generator set shall maintain service parts inventory at a central location that is accessible to the service location 24 hours per day, 365 days per year.

D. The generator set shall be serviced by a local service organization that is trained and factory certified in generator set service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.

E. The manufacturer shall maintain model and serial number records of each generator set provided for at least 20 years.

F. The warranty shall not derive 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.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials and equipment shall be new (less than 1 year old when turned over to the Owner).

2.2 MANUFACTURER

A. Acceptable Manufacturers

1. Cummins/Onan.
2. Kohler Power Systems.
3. MTU/Detroit Diesel.
4. Fabick/Caterpillar

B. These specifications, installation design, the heating/ventilation design, and the fuel system design are based upon the first named manufacturer. If the contractor elects to supply a different manufacturer, then the contractor shall be responsible for adjusting the installation of the standby engine/generator set to satisfy the requirements of that manufacturer's equipment.

C. Alternate equipment to the named manufacturers will only be considered if the following information is submitted ten days prior to the bid date:

1. Certified dimensional data.
2. Verification of adequate cooling/combustion air for the installation.
3. Complete interconnecting wiring and piping diagrams.
4. Manufacturers certification of prototype testing.
5. Load study/profile showing non-overloading of genset under steady-state conditions and during motor starting.
6. Manufacturer's product literature and performance data, sufficient to verify compliance to specification requirements.
7. A paragraph-by-paragraph specification compliance statement, describing the differences between the specified and the proposed equipment.
8. Short circuit study of the load circuits to verify that selective coordination occurs and that thermal-magnetic stresses on components will not exceed the specified ratings.
9. Listing of similar projects and owner contact information for projects completed during the previous five years.

2.3 GENERATOR SET

A. Ratings

1. The generator set shall operate at 1800 rpm and at a voltage of: 120/208 Volts AC, Three-phase, Four-wire, 60 hertz.
2. The generator set shall be rated at 250 kW, 325 kVA at 0.8 PF, standby rating, based on site conditions of: Altitude 1000 feet, ambient temperatures up to 100 degrees F.
3. The generator set rating shall be based on emergency/standby service.

B. Performance

1. Voltage regulation shall be plus or minus 1.0 percent for any constant load between no load and rated load for both parallel and non-parallel applications. Random voltage variation with any steady load from no load to full load shall not exceed plus or minus 0.5 percent.

2. Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed plus or minus 0.25%.
3. The engine-generator set shall be capable of single step load pick up of 100% nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.
4. Motor starting capability shall be a minimum of 791 kVA. The generator set shall be capable of sustaining a minimum of 90% of rated no load voltage with the specified kVA load at near zero power factor applied to the generator set.
5. The alternator shall produce a clean AC voltage waveform, with not more than 5% total harmonic distortion at full linear load, when measured from line to neutral, and with not more than 3% in any single harmonic. Telephone influence factor shall be less than 40.

C. Construction

1. The engine-generator set shall be mounted on a heavy-duty steel base to maintain alignment between components. The base shall incorporate a corrosion resistant battery tray with hold-down clamps within the rails.

D. Connections

1. The generator set load connections shall be composed of silver or tin plated copper bus bars, drilled to accept mechanical or compression terminations for the number and type cables shown on the drawings. Sufficient lug space shall be provided for use with cables of the number and size as shown on the drawings.
2. Power connections to auxiliary devices shall be made at the devices, with required protection located at the power distribution panel as shown on the drawings.
3. Generator set control interfaces to other system components shall be made on a common, permanently labeled terminal block assembly.

2.4 ENGINE AND ENGINE EQUIPMENT

A. The engine shall be natural gas fueled, radiator and fan cooled. Minimum displacement shall be 677 cubic inches, with 6 cylinders. The horsepower rating of the engine at its minimum tolerance level shall be sufficient to drive the alternator and all connected accessories.

B. Engine accessories and features shall include:

1. Complete engine fuel system, including all pressure regulators, strainers, and control valves. The fuel system shall be plumbed to the generator set skid for ease of site connections to the generator set.
2. An electronic governor system shall provide automatic isochronous frequency regulation.
3. Electric starter(s) capable of three complete cranking cycles without overheating.
4. Positive displacement, mechanical, full pressure, lubrication oil pump.
5. Full flow lubrication oil filters with replaceable spin-on canister elements and dipstick oil level indicator.
6. Replaceable dry element air cleaner with restriction indicator.
7. Flexible fuel lines.
8. Engine mounted battery charging alternator, 40-ampere minimum, and solid-state voltage regulator.

9. Coolant heater:

    a. Engine mounted, thermostatically controlled, coolant heater(s) for each engine. Heater voltage shall be as shown on the project drawings. The coolant heater shall be UL499 listed and labeled.
    b. The coolant heater shall be installed on the engine with silicone hose connections. Steel tubing shall be used for connections into the engine coolant system wherever the length of pipe run exceeds 12 inches. The coolant heater installation shall be specifically designed to provide proper venting of the system. The coolant heater shall be installed using quick disconnect couplers to isolate the heater for replacement of the heater element. The quick disconnect/automatic sealing couplers shall allow the heater element to be replaced without draining the engine cooling system or significant coolant loss.
    c. The coolant heater shall be provided with a 12VDC thermostat, installed at the engine thermostat housing. An AC power connection box shall be provided for a single AC power connection to the coolant heater system.
    d. The coolant heater(s) shall be sized as recommended by the engine manufacturer to warm the engine to a minimum of 100F (40C) in a 40F ambient, in compliance with NFPA110 requirements, or the temperature required for starting and load pickup requirements of this specification.

10. Provide vibration isolators, spring/pad type, quantity as recommended by the generator set manufacturer. Isolators shall include seismic restraints if required by site location.
11. Starting and Control Batteries shall be calcium/lead antimony type, 12 volt DC, sized as recommended by the engine manufacturer, complete with battery cables, connectors, and corrosion resistant battery tray.

2.5 AC GENERATOR

A. The AC generator shall be; synchronous, four pole, 2/3 pitch, revolving field, drip-proof construction, single pre-lubricated sealed bearing, air-cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc. All insulation system components shall meet NEMA MG1 temperature limits for Class H insulation system. Actual temperature rise measured by resistance method at full load shall not exceed 125 degrees Centigrade.

B. The generator shall be capable of delivering rated output (kVA) at rated frequency and power factor, at any voltage not more than 5 percent above or below rated voltage.

C. A permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single-phase or three-phase fault at approximately 300% of rated current for not more than 10 seconds.

D. The sub-transient reactance of the alternator shall not exceed 12 percent, based on the standby rating of the generator set.

2.6 ENGINE GENERATOR SET CONTROL

A. A NEMA 1 enclosed control panel shall be mounted on the generator set with vibration isolators. The control shall be vibration isolated and prototype tested to verify the durability of all components under the vibration conditions encountered.

B. The generator set mounted control shall include the following features and functions:

1. Three-position control switch labeled RUN/OFF/AUTO. In the RUN position the generator set shall automatically start and accelerate to rated speed and voltage. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
2. RESET switch. The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
3. PANEL LAMP switch. Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power.
4. Generator Set AC Output Metering: The generator set shall be provided with a metering set with the following features and functions:

    a. Analog AC Voltmeter, dual range, 90 degree scale, 2% accuracy; Analog AC Ammeter, dual range, 90 degree scale, 2% accuracy; Analog Frequency/RPM meter, 45-65 Hz, 1350-1950 RPM, 90 degree scale, +/- 0.6 Hz accuracy.
    b. Seven position phase selector switch with OFF position to allow meter display of current and voltage in each generator phase. When supplied with re-connectable generators, the meter panel shall be re-connectable for the voltage specified.

5. Generator Set Alarm and Status Display: The generator set shall be provided with alarm and status indicating lamps to indicate non-automatic generator status, and existing alarm and shutdown conditions. The non-automatic indicating lamp shall be red and shall flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location. The lamp condition shall be clearly apparent under bright room lighting conditions. The generator set control shall indicate the existence of the following alarm and shutdown conditions on the display panel:

    a. Low oil pressure (alarm).
    b. Low oil pressure (shutdown).
    c. Low coolant temperature (alarm).
    d. High coolant temperature (alarm).
    e. High coolant temperature (shutdown).
    f. Over-crank (shutdown).
    g. Over-speed (shutdown).
    h. Low fuel (alarm).
    i. In addition, provisions shall be made for indication of two customer-specified alarm or shutdown conditions.

6. Engine Status Monitoring: The following devices shall be provided on the generator set control:

    a. Engine oil pressure gauge.
    b. Engine coolant temperature gauge.

c. Engine operation hour gauge.
d. Battery voltage (DC volts).

7. Engine Control Functions. The control system provided shall include a cycle cranking system, which shall be for 3 cranking periods of 15 seconds each, with 15 second rest period between cranking periods. Fail to start shall be indicated by operation of the over-crank alarm indication lamp. The control system shall also include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification.
8. Alternator Control Functions:

   a. The generator set shall include an automatic voltage regulation system that is matched and prototype tested with the governing system provided. It shall be immune from misoperation due to load-induced voltage waveform distortion and provide a pulse-width modulated output to the alternator exciter. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below a threshold of [58-59] HZ.
   b. Voltage adjusting rheostat, locking screwdriver type, to adjust voltage +/- 5% from rated value.

9. Control Interfaces for Remote Monitoring. Provide the following features in the control system:

   a. Form "C" dry common alarm contact set rated 2A @ 30VDC to indicate existence of any alarm or shutdown condition on the generator set.
   b. One set of contacts rated 2A @ 30VDC to indicate generator set is ready to load. The contacts shall operate when voltage and frequency are greater than 90% of rated condition.
   c. A fused 10-amp switched 12VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit whenever the generator set is running.
   d. A fused 20-amp 12VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit at all times from the engine starting/control batteries.

10. Provide and install a 20-light LED type remote alarm annunciator with horn, located as shown on the drawings or in a location that can be conveniently monitored by facility personnel. The remote annunciator shall provide all the audible and visual alarms called for by NFPA Standard 110 for level 1 systems; and in addition, shall provide indications for high battery voltage, low battery voltage, loss of normal power to the charger. Spare lamps shall be provided to allow future addition of other alarm and status functions to the annunciator. Provisions for labeling of the annunciator in a fashion consistent with the specified functions shall be provided. Alarm silence and lamp test switch (es) shall be provided. LED lamps shall be replaceable and indicating lamp color shall be capable of changes needed for specific application requirements. Alarm horn shall be switchable for all annunciation points. Alarm horn (when switched on) shall sound for first fault, and all subsequent faults, regardless of whether first fault has been cleared, in compliance with NFPA110 3-5.6.2. Annunciator shall be powered by generator battery.
11. The generator set shall be provided with a mounted main line circuit breaker, sized to carry the rated output current of the generator set on a continuous basis as shown on the

drawings. Circuit breaker shall be equipped with shunt trip and shall automatically open on a genset shutdown alarm.

C. Sequence of Operation

1. Generator set shall start on receipt of a start signal from remote equipment.
2. The generator set control shall initiate the starting sequence for the generator set.
3. The engine shall accelerate to rated speed and the alternator to rated voltage. Excitation shall be disabled until the engine has exceeded programmed idle speed and regulated to prevent over voltage conditions and oscillation as the engine accelerates and the alternator builds to rated voltage.
4. When all start signals have been removed from the generator set, the generator set control shall switch off the excitation system and shall shut down.
5. Any start signal received after the time stop sequence has begun shall immediately terminate the stopping sequence and return the generator set to isochronous operation.

2.7 ENGINE EXHAUST SYSTEM

A. Provide exhaust silencer(s) for each engine of size and type as recommended by the generator set manufacturer and approved by the engine manufacturer. The mufflers shall be critical grade. Exhaust system shall be installed according to the engine manufacturer's recommendations and applicable codes and standards.

B. Provide stainless steel, seamless flexible exhaust manifold connector.

C. Silencer and exhaust piping shall be insulated with rigid insulation to maintain a surface temperature of not more than 150 degrees F. Provide 0.016-inch aluminum jacket complete with crimped end covers, secured with stainless steel sheet metal screws and rubber coated washers. Insulation system shall not interfere with flexible fittings.

D. Provide exhaust thimble(s) for exhaust penetration of exterior walls. Construction shall be fireproof.

2.8 NATURAL GAS ENGINE FUEL SYSTEM

A. The mechanical contractor shall provide fuel-piping system.

B. Provide appropriately sized fuel regulator.

C. Engine fuel consumption shall not exceed 2115 cfh at a pressure of 7-11 inches of water column.

2.9 OUTDOOR WEATHER-PROTECTIVE SOUND ATTENUATING HOUSING (LEVEL 2)

A. The generator set shall be provided with a sound-attenuated housing which allows the generator set to operate at full rated load in the ambient conditions previously specified. The enclosure shall reduce the sound pressure level of the generator set while operating at full rated load to a maximum of 73.6 dBA at any location 7 meters from the generator set in a free field environment. Housing configuration and materials used may be of any suitable design which

meets application needs, except that acoustical materials used shall be oil and water resistant. No foam materials shall be used unless they can be demonstrated to have the same durability and life as fiberglass. (Select maximum sound pressure level from manufacturer. Sound data sheet for selected model.)

B. The enclosure shall include hinged doors for access to both sides of the engine and alternator, and the control equipment. Key-locking and pad-lockable door latches shall be provided for all doors. Door hinges shall be stainless steel.

C. The enclosure shall be provided with an exhaust silencer that is mounted inside of the enclosure and allows the generator set package to meet specified sound level requirements. Silencer and exhaust shall include a rain cap and rain shield.

D. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturers standard color. All surfaces of all metal parts shall be primed and painted.

E. Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts shall not be acceptable. Fasteners used shall be corrosion resistant and designed to minimize marring of the painted surface when removed for normal installation or service work.

F. Enclosure shall be deigned as rodent proof.

G. Provide the basic electrical package enclosure with the following equipment:

1. Three-phase 30A-120/208V load center. Factory installed and pre-wired within generator housing with the following connected loads:
2. Lighting and switch.
3. GFI receptacle.
4. Enclosure Heater
5. Coolant Heater.
6. Battery Heater.
7. Motorized Air Inlets and Outlets.
8. Emergency Stop Switch.
9. Float type battery charger rated 6 amps minimum. The battery charger shall include an ammeter for display of charging current and shall have fused AC inputs and DC outputs. The charger shall also include fault indications for high and low dc voltage, and supply power failed, and dry contacts for external indication of these fault conditions. Display supply power failed indication on the ATS control panel.

2.10 ACCESSORIES

A. Provide supply of consumables (air cleaner, oil filter, etc) in sufficient quantity to last for one year from the date of substantial completion.

PART 3 - EXECUTION

3.1 EXAMINATION

A. The Contractor shall have overall system responsibility and shall provide all materials and labor necessary provide a complete and operable system and comply with all requirements of this section.

B. The engine/generator set manufacturer shall be responsible for certifying the correctness of installation for all work related to the standby power system regardless of who performs the installation work.

C. The contract drawings are diagrammatic in nature; it shall be the responsibility of the manufacturer to supplement the contract drawings and complete the final design of the standby power system and to coordinate exact requirements with the installing contractors.

3.2 FIELD MEASUREMENTS

A. Field verify with exact measurements, the available mounting space for standby power system equipment. Identify deficiencies prior to beginning installation.

3.3 DELIVERY STORAGE AND HANDLING

A. It shall be the responsibility of the installing contractor to receive all standby power system equipment at the job site. Carefully inspect all equipment for damage prior to accepting from the shipping agency. Do not accept shipment if damage is evident.

B. The Contractor shall exercise due diligence in storing, protecting, and moving standby power system equipment. Damaged or worn equipment will not be accepted and will be replaced at no additional cost to the Owner.

3.4 INSTALLATION

A. General:

1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer’s recommendations.
2. Install all fixtures, materials, assemblies and equipment in strict accordance with manufacturer’s recommendations and instructions. Consult manufacturer for all wiring diagrams, schematics, sizes, outlets, etc. before installing.
3. Start of installation shall not begin until areas are broom clean, properly lighted, exterior enclosing walls in place, exterior windows glazed, roof completely installed to prevent weather damage to equipment, and written notice received from Architect stating that these conditions exist at building site.

B. Install equipment in locations as indicated on the contract documents. Adjust locations as needed to ensure operability, serviceability, and compliance with all applicable codes and standards.

C. Installation shall be completely tested prior to start-up. This work includes verification of all field wiring continuity and proper termination of wiring.

D. The Contractor shall install the equipment by in accordance with final submittals and contract documents. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.

E. Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The Contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.

F. Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer’s instructions and seismic requirements of the site.

G. Equipment shall be initially started and operated by representatives of the manufacturer.

H. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to final testing of the system.

I. Provide 8” concrete pad between floor and generator skid.

3.5 TESTING AND START-UP SERVICES

A. Standby power system supplier shall provide installation and start-up services required to place the complete system into operation. Installation service shall include a preliminary visit to assist with and verify correct mechanical and electrical installations. Start-up service shall include checkout within one month of commissioning for the purpose of verifying correct operation of the generator set’s individual systems, and for making any necessary final adjustments and corrections.

B. The complete installation shall be tested for compliance with the specification following completion of all site work. Representatives of the manufacturer shall conduct testing, with required fuel supplied by Contractor. The Engineer shall be notified in advance and shall have the option to witness the tests.

C. Installation acceptance tests to be conducted on-site shall include a "cold start" test, a two-hour full load test, and a one step rated load pickup test in accordance with NFPA 110. Provide a resistive load bank and make temporary connections for full load test. Provide all required cables and make accommodations for routing of cables to allow load bank to be located outside of the building.

D. Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service and observing proper operation of the system for at least 2 hours. Coordinate timing and obtain approval for start of test with site personnel. Verify correct genset operation with transfer switch programmed transition functionality per 26 36 00.

E. Test alarm and shutdown circuits by simulating conditions. Adjust output voltage and engine speed.

F. Record kW, Amps, Volts, Frequency, oil pressure, coolant temperature, and room temperature at twenty-minute intervals during the test and report findings to Engineer in writing.

G. Verify operation of room ventilation system including interlocks with generator equipment.

H. Verify fuel system installation and capacity.

3.6 OWNER TRAINING

A. The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than 4 hours in duration and the class size shall be limited to five persons. Training date shall be coordinated with the facility Owner.

B. Describe the loads connected to the standby power system along with restrictions for future use.

3.7 SPARE EQUIPMENT (NONE)

END OF SECTION 263200

SECTION 263238 – GENERATOR CONNECTION BOX

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.2 APPLICABLE PUBLICATIONS

A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent applicable.

1. American National Standards Institute/National Fire Protection Agency (ANSI/NFPA), Specifications and Standards, current edition:

a. NFPA70 – National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 702.
b. UL (Underwriters Laboratories) are listed by the American Federal Occupational Safety and Health. This equipment must comply with standard UL 1008 Supplement SB -- Requirements for Inlet Assemblies for Transfer Switch Equipment.
c. Administration (OSHA) under NRTL (Nationally Recognized Testing Laboratory) program.

1.3 DESCRIPTION OF WORK

A. Furnish and install complete factory assembled generator connection box to provide automatic transfer of a portable generator to the building's NEC article 702 loads as shown on the drawings.

1.4 RELATED WORK ELSEWHERE

A. For the purpose of obtaining a complete and integrated standby power system, the following sections shall be included under the scope of this section:

1. Section 26 32 00 – Standby Engine/Generator Set
2. Section 26 36 00 – Transfer Switch

1.5 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

B. The following information shall be submitted in addition to items listed above:

1. Wiring diagrams indicating wire size and type for each individual piece of equipment.

2. Complete diagrams indicating all equipment and interconnecting components with indication of location of each device.
3. Complete plan, side and elevation view drawings of skid-mounted equipment and exact component layout.
4. All drawings must be in CADD format.
5. Manufacturer certification of prototype testing.
6. Manufacturers published warranty documents.
7. Plan and elevation views with certified overall dimensions, as well as wiring interconnection details.
8. Interconnection wiring diagrams showing all external connections required with field wiring terminals marked in a consistent point-to-point manner.
9. Manufacturer's installation instructions.

1.6 OPERATION & MAINTENANCE MANUALS

A. Submit Operations & Maintenance Manuals in accordance with Section 26 05 04.

1.7 FACTORY TESTING

A. The generator connection box supplier shall perform a complete operational test on the equipment prior to shipping from the factory. Provide a certified test report. Fully test supplied equipment at the factory for function and performance.

B. Factory testing may be witnessed by the Owner and Consulting Engineer. Costs for travel expenses will be the responsibility of the Owner and Consulting Engineer. Supplier is responsible to provide two weeks notice for testing.

1.8 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. The following shall be provided in addition to items listed above.

1. Arrange pre-installation meeting.
2. Factory Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer’s products that are similar in material, design, and extent to those indicated for this Project.
3. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
4. Manufacturer’s Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.
5. Manufacturer must carry replacement parts.

C. The generator set manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

D. All materials, equipment, and parts shall be new and unused of current manufacture.

E. System supplier shall be responsible for providing all necessary accessories required for a complete and operable system.

1.9 WARRANTY

A. The generator connection box equipment shall be warranted for a period of not less than 5 years from the date of commissioning against defects in materials and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

C. The manufacturer of the generator connection box shall maintain service parts inventory at a central location that is accessible to the service location 24 hours per day, 365 days per year.

D. The generator connection box shall be serviced by a local service organization that is trained and factory certified in generator connection box service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.

E. The warranty shall not derive 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.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials and equipment shall be new (less than 1 year old when turned over to the Owner).

2.2 MANUFACTURER

A. Acceptable Manufacturers

1. PSI Control Solutions, psicontrolsolutions.com 980-498-3161.
2. States Manufacturing
3. Or Equal.

2.3 GENERATOR CONNECTION BOX

A. Combination Manual Transfer Switch with Cam Lock Receptacles.

B. Generator Connection Box designed to function as a permanently-installed, inlet-style assembly rated

C. 600 V or less for system voltages of 208-600 V.

D. Generator Connection Box must comply with standard UL 1008 Supplement SB – Requirements for Inlet Assemblies for Transfer Switch Equipment.

E. Generator Connection Box does not include any interlocking equipment to prevent an operator

F. From inadvertently energizing multiple power sources on the same panelboard.

G. Any system that includes multiple sources of power should be designed to ensure that the system can be safely transitioned between sources.

2.4 STANDARD FEATURES

A. Quick, safe connection of a mobile generator set to the source terminals of a transfer switch or Equivalent standby power disconnect.

B. Kirk-key interlock.

C. Functions as a permanently-installed, inlet-style assembly rated 600 VAC or less.

D. Mechanical lugs for connection to the transfer switch or standby power disconnect.

E. Insulating barrier to separate permanent wiring from cam-lock connections.

F. Generator connection with color-coded cam-lock connectors.

G. Five (5) color-coded cam-lock connectors for connection to customer-supplied Type W cables.

H. Contact point to annunciate at Generator Annunciator when permanent emergency generator is disconnected from the emergency system.

I. Hinged bottom panel for cable access to be secured when not in use.

J. NEMA Type 3R enclosure for outdoor or indoor installation.

K. Hinged, lockable door for controlled access with Glastic TM barrier inner panels, upper and lower.

2.5 LOCATION

A. Generator Connection Box is designed to be wall mounted in a NEMA 3R environment. Working clearances must comply with Section 110-26 of the National Electrical Code (NEC).

2.6 FIELD WIRING DETAILS

A. Disconnect Side: Ampacity to match Automatic Transfer Switch, Lugs per phase - 2 Mechanical, Wire/Range 3/0 -- 600 KCMIL

B. Generator Side: 1 Connector per Phase - Cam-Lock Style

C. Phases and wires: 3-phase, 4-wire plus ground.

D. Connect load lugs of Generator Connection Box to the transfer switch load side connection lugs.

PART 3 - EXECUTION

3.1 EXAMINATION

A. The Contractor shall have overall system responsibility and shall provide all materials and labor necessary provide a complete and operable system and comply with all requirements of this section.

B. The generator connection box manufacturer shall be responsible for certifying the correctness of installation for all work related to the standby power system regardless of who performs the installation work.

C. The contract drawings are diagrammatic in nature; it shall be the responsibility of the manufacturer to supplement the contract drawings and complete the final design of the standby power system and to coordinate exact requirements with the installing contractors.

3.2 FIELD MEASUREMENTS

A. Field verify with exact measurements, the available mounting space for the generator connection box equipment. Identify deficiencies prior to beginning installation.

3.3 DELIVERY STORAGE AND HANDLING

A. It shall be the responsibility of the installing contractor to receive generator connection box equipment at the job site. Carefully inspect all equipment for damage prior to accepting from the shipping agency. Do not accept shipment if damage is evident.

B. The Contractor shall exercise due diligence in storing, protecting, and moving the generator connection box equipment. Damaged or worn equipment will not be accepted and will be replaced at no additional cost to the Owner.

3.4 INSTALLATION

A. General:

1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer's recommendations.
2. Install all fixtures, materials, assemblies and equipment in strict accordance with manufacturer's recommendations and instructions. Consult manufacturer for all wiring diagrams, schematics, sizes, outlets, etc. before installing.
3. Start of installation shall not begin until areas are broom clean, properly lighted, exterior enclosing walls in place, exterior windows glazed, roof completely installed to prevent weather damage to equipment, and written notice received from Architect stating that these conditions exist at building site.

B. Install equipment in locations as indicated on the contract documents. Adjust locations as needed to ensure operability, serviceability, and compliance with all applicable codes and standards.

C. Installation shall be completely tested prior to start-up. This work includes verification of all field wiring continuity and proper termination of wiring.

D. The Contractor shall install the equipment by in accordance with final submittals and contract documents. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.

E. Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The Contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.

F. Equipment shall be initially started and operated by representatives of the manufacturer.

G. Generator Connection Box only for connection of a towable or non-stationary generator set to the source terminals of a transfer switch, such that the inlets are only energized from the generator.

H. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to final testing of the system.

I. Generator Connection Box shall NOT be connected or disconnect under load.

J. Generator Connection Box shall be mounted to a flat surface of sufficient strength to support the weight of the Generator Connection Box. Install the Generator Connection Box so that the top of the enclosure is level. Fasteners must be suitable for fastening to the mounting surface material with strength to support the weight of the Generator Connection Box.

3.5 TESTING AND START-UP SERVICES

A. The generator connection box system supplier shall provide installation and start-up services required to place the complete system into operation. Installation service shall include a preliminary visit to assist with and verify correct mechanical and electrical installations. Start-up service shall include checkout within one month of commissioning for the purpose of verifying correct operation of the generator set's individual systems, and for making any necessary final adjustments and corrections.

B. The complete installation shall be tested for compliance with the specification following completion of all site work. Representatives of the manufacturer shall conduct testing, with required fuel supplied by Contractor. The Engineer shall be notified in advance and shall have the option to witness the tests.

C. Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service, and observing proper operation of the system for at least 2 hours. Coordinate timing and obtain approval for start of test with site personnel. Verify correct genset operation with transfer switch programmed transition functionality per 26 36 00.

D. Test alarm and shutdown circuits by simulating conditions. Adjust output voltage and engine speed.

3.6 OWNER TRAINING

A. The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than 1 hour in duration and the class size shall be limited to five persons. Training date shall be coordinated with the facility Owner.

B. Describe the loads connected to the standby power system along with restrictions for future use. Coordinate this discussion with the process instrumentation control system integrator to include automatic step start control and load control.

3.7 SPARE EQUIPMENT (NONE)

END OF SECTION 263238

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SECTION 263600 - TRANSFER SWITCH

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.2 APPLICABLE PUBLICATIONS

A. The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent applicable.

1. American National Standards Institute/National Fire Protection Agency (ANSI/NFPA), Specifications and Standards, current edition:

    a. NFPA20 – Fire Pumps. Transfer switches serving fire pumps shall be specifically listed and labeled for that application.
    b. NFPA70 – National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
    c. NFPA99 – Essential Electrical Systems for Health Care Facilities.
    d. NFPA110 – Emergency and Standby Power Systems. The transfer switch shall meet all requirements for Level 1 systems.

2. Canadian Standards Association (CSA), Specifications and Standards, current edition:

    a. CSA C22.2, No. 14 – M91 Industrial Control Equipment.
    b. CSA 282, 1989 Emergency Electrical Power Supply for Buildings.

3. European Committee for Electrotechnical Standardization (CENELEC), Specifications and Standards, current edition:

    a. EN55011, Class B Radiated Emissions.
    b. EN55011, Class B Conducted Emissions.

4. International Electrotechnical Commission (IEC), Specifications and Standards, current edition:

    a. IEC 1000-4-2 (EN 61000-4-2) Electrostatic Discharge Immunity.
    b. IEC 1000-4-3 (EN 61000-4-3) Radiated Field Immunity.
    c. IEC 1000-4-4 (EN 61000-4-4) Fast Transients Immunity.
    d. IEC 1000-4-5 (EN 61000-4-5); AC Surge Immunity. Similar waveforms are described in ANSI/IEEE 62.41-1991.
    e. IEC 1000-4-6 Conducted Field Immunity.
    f. IEC 1000-4-11 Voltage Dip Immunity.

5. Institute of Electrical and Electronics Engineers, Specifications and Standards, current edition:

    a. IEEE446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.

6. National Electrical Manufacturers Association (NEMA), Specifications and Standards, current edition:

    a. NEMA ICS10-1993 – AC Automatic Transfer Switches.

7. Underwriters Laboratories, Inc. (UL), Specifications and Standards, current edition:

    a. UL1008. The transfer switch shall be UL listed and labeled.

1.3 DESCRIPTION OF WORK

A. Provide complete factory assembled power transfer equipment with field programmable digital electronic controls designed for fully automatic operation and including: surge voltage isolation, voltage sensors on all phases of both sources, linear operator, permanently attached manual handles, positive mechanical and electrical interlocking, and mechanically held contacts for both sources.

B. Provide factory test, startup by a supplier authorized by the manufacturer, and on-site testing of the system. Technicians specifically trained to support the product and employed by the generator set supplier shall service the transfer switches.

C. The generator set manufacturer shall warrant transfer switches to provide a single source of responsibility for all the products provided.

D. The automatic transfer switch specified herein shall be equipped with a time delay in the neutral position (programmed transition). Alternative methods for transfer control are not acceptable.

E. The Contractor shall have overall system responsibility and shall provide all materials and labor necessary provide a complete and operable system and comply with all requirements of this section.

F. The engine/generator set manufacturer shall be responsible for certifying the correctness of installation for all work related to the standby power system regardless of who performs the installation work.

G. The contract drawings are diagrammatic in nature; it shall be the responsibility of the manufacturer to supplement the contract drawings and complete the final design of the standby power system and to coordinate exact requirements with the installing contractors.

1.4 RELATED WORK ELSEWHERE

A. For the purpose of obtaining a complete and integrated standby power system, the following sections shall be included under the scope of this section:

1. Section 26 32 00 – Standby Engine/Generator Set.
2. Section 26 32 38 – Generator Connection Box

B. The following sections include work which is related to the Standby Engine/Generator Set, but which is not included under the scope of this section:

1. Division 23 – Heating, Ventilation and Air Conditioning.
2. Division 26, 27, and 28 – Electrical.

1.5 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

B. General requirements specific to this section include:

1. Submit complete and integrated document containing all equipment included under the scope of this section as part of the submittal document for the Standby Engine/Generator Set.
2. Submittal shall be complete, neat, orderly, and indexed with tabbed dividers. Partial submittals will not be accepted.
3. Clarity and completeness are of prime importance. Acceptability of submittal drawings shall be at the sole discretion of the Engineer in regards to this requirement.
4. Additional requirements for the various subsystems are specified in the corresponding sections.

C. Submit the following information:

1. Manufacturer’s product literature and performance data, sufficient to verify compliance to specification requirements.
2. A paragraph-by-paragraph specification compliance statement, describing the differences between the specified and the proposed equipment.
3. Manufacturers published warranty documents.
4. Shop drawings showing plan and elevation views with certified overall dimensions, as well as wiring interconnection details.
5. Interconnection wiring diagrams showing all external connections required; with field wiring terminals marked in a consistent point-to-point manner.
6. Manufacturer's installation instructions.

1.6 OPERATION & MAINTENANCE MANUALS AND INSTRUCTIONS

A. Submit Operations & Maintenance Manuals in accordance with Section 26 05 04.

B. Submit final revised shop drawings incorporating any modifications made as a result of installation, start-up, operational testing, or for any other cause. Submit results of all field-testing and corrective actions taken for all operational parameters.

C. Submit manufacturers standard operation & maintenance information including installation manuals and safety instructions.

D. Submit contact list identifying names, addresses, telephone numbers, and any additional contact information for each equipment service organization involved with the Standby Engine/Generator Set.

E. Submit detailed operation and maintenance procedures for each major equipment item; include description of operation for all modes of operation, routine maintenance procedures, and trouble-shooting guide.

F. Submit listing of spare parts provided under this contract and of recommended additional spare parts not provided under this contract along with costs.

1.7 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. The Automatic Transfer Switch manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

C. All materials, equipment, and parts shall be new and unused of current manufacture.

D. System supplier shall be responsible for providing all necessary accessories required for a complete and operable system.

E. The Automatic Transfer Switch manufacturer shall have been engaged in the manufacture of generator sets for a minimum of ten years and shall have a factory trained service and parts organization located within 100 miles of the jobsite.

F. All control equipment shall be the standard product of the engine/generator set manufacturer. Controls systems that are supplied by a subcontractor of the manufacturer and which are not incorporated into the standard documentation of the manufacturer will not be acceptable.

1.8 WARRANTY

A. The automatic transfer switch and associated equipment shall be warranted for a period of not less than five years from the date of commissioning against defects in materials and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

C. The manufacturer of the transfer switch shall maintain service parts inventory at a central location that is accessible to the service location twenty-four hours per day, three hundred sixty-five days per year.

D. The automatic transfer switch shall be serviced by a local service organization that is trained and factory certified in automatic transfer switch service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call twenty-four hours per day, three hundred sixty-five days per year.

E. The manufacturer shall maintain model and serial number records of each transfer switch provided for at least twenty years.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials and equipment shall be new (less than 1 year old when turned over to the Owner).

B. Acceptable Manufacturers:

1. Cummins/Onan.
2. Kohler Power Systems.
3. MTU/Detroit Diesel.
4. Fabick/Caterpillar

C. The automatic transfer switch shall be provided as part of a complete, integrated standby power system. As such, the manufacturer of the Standby Engine/Generator Set shall provide it.

2.2 POWER TRANSFER SWITCH

A. Ratings

1. Refer to the project drawings for specifications on the sizes and types of transfer switch equipment, withstand and closing ratings, number of poles, voltage and ampere ratings, enclosure type, and accessories.
2. Main contacts shall be rated for 600 Volts AC, minimum.
3. Transfer switches shall be rated to carry 100 percent of rated current continuously in the enclosure supplied, in ambient temperatures of -40 to +60 degrees C, relative humidity up to 95 percent (non-condensing), and altitudes up to 10,000 feet (3000M).
4. Transfer switch equipment shall have withstand and closing ratings (WCR) in RMS symmetrical amperes greater than the available fault currents determined by the short-circuit study required by section 26 05 73 at the specified voltage. The transfer switch and its upstream protection shall be coordinated. The transfer switch shall be third party listed and labeled for use with the specific protective device(s) installed in the application.

B. Construction

1. Transfer switches shall be double-throw, electrically and mechanically interlocked, and mechanically held in the source 1 and source 2 positions. The transfer switch shall be specifically designed to transfer to the best available source if it inadvertently stops in a neutral position.
2. Transfer switches rated through 1000 amperes shall be equipped with permanently attached manual operating handles and quick-break, quick-make over-center contact

mechanisms. Transfer switches over 1000 amperes shall be equipped with manual operators for service use only under de-energized conditions.

3. Main switch contacts shall be high-pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishing. Arc chutes shall have insulating covers to prevent inter-phase flashover.
4. Transfer switch internal wiring shall be composed of pre-manufactured harnesses that are permanently marked for source and destination. Harnesses shall be connected to the control system by means of locking disconnect plug(s), to allow the control system to be easily disconnected and serviced without disconnecting power from the transfer switch mechanism.
5. Power transfer switch shall be provided with flame retardant transparent covers to allow viewing of switch contact operation but prevent direct contact with components that could be operating at line voltage levels.
6. Transfer switches designated as 4-pole switches on the drawings shall be provided with a switched neutral pole. The neutral pole shall be of the same construction and have the same ratings as the phase poles. All poles shall be switched simultaneously using a common crossbar. Substitute equipment using overlapping neutral contacts is not acceptable.
7. Transfer switches designated as 3-pole switches on the drawings shall be provided with a neutral bus and lugs. The neutral bus shall be sized to carry 100 percent of the current designated on the switch rating.

C. Connections

1. Field control connections shall be made on a common terminal block that is clearly and permanently labeled.
2. Transfer switch shall be provided with AL/CU mechanical lugs sized to accept the full output rating of the switch. Lugs shall be suitable for the number and size of conductors shown on the drawings.

2.3 TRANSFER SWITCH CONTROL

A. Operator Panel. Each transfer switch shall be provided with a control panel to allow the operator to view the status and control operation of the transfer switch. The operator panel shall be a sealed membrane panel rated NEMA 3R/IP53 or better (regardless of enclosure rating) that is permanently labeled for switch and control functions.

B. Operator panel and features and capabilities shall include:

1. High intensity LED lamps to indicate the source that the load is connected to (source 1 or source 2); and which source(s) are available. Source available LED indicators shall operate from the control microprocessor to indicate the true condition of the sources as sensed by the control.
2. High intensity LED lamps to indicate that the transfer switch is “not in auto” (due to control being disabled or due to bypass switch (when used) enabled or in operation) and “Test/Exercise Active” to indicate that the control system is testing or exercising the generator set.
3. “OVERRIDE” pushbutton to cause the transfer switch to bypass any active time delays for start, transfer, and retransfer and immediately proceed with its next logical operation.

4. "TEST" pushbutton to initiate a preprogrammed test sequence for the generator set and transfer switch. The transfer switch shall be programmable for test with load or test without load.
5. "RESET/LAMP TEST" pushbutton that will clear any faults present in the control, or simultaneously test all lamps on the panel by lighting them.
6. The control system shall continuously log information on the number of hours each source has been connected to the load, the number of times transferred, and the total number of times each source has failed. This information shall be available via a PC-based service tool or an operator display panel.
7. Security Key Switch to allow the user to inhibit adjustments, manual operation or testing of the transfer switch unless key is in place and operated.
8. Vacuum fluorescent alphanumeric display panel with push-button navigation switches. The display shall be clearly visible in both bright (sunlight) and no light conditions. It shall be visible over an angle of at least 120 degrees. The Alphanumeric display panel shall be capable of providing the following functions and capabilities:

    a. Display source condition information, including AC voltage for each phase of normal and emergency source, frequency of each source. Voltage for all three phases shall be displayed on a single screen for easy viewing of voltage balance.
    b. Display source status, to indicate source is connected or not connected.
    c. Display load data, including 3-phase AC voltage, 3-phase AC current, frequency, KW, KVA, and power factor. Voltage and current data for all phases shall be displayed on a single screen.
    d. The display panel shall allow the operator to view and make the following adjustments in the control system, after entering an access code:

        1) Set nominal voltage and frequency for the transfer switch.
        2) Adjust voltage and frequency sensor operation set points.
        3) Set up time clock functions.
        4) Set up load sequence functions.
        5) Enable or disable control functions in the transfer switch, including program transition.
        6) Set up exercise and load test operation conditions, as well as normal system time delays for transfer time, time delay start, stop, transfer, and retransfer.

    e. Display Real time Clock data, including date, and time in hours, minutes, and seconds. The real time clock shall incorporate provisions for automatic daylight savings time and leap year adjustments. The control shall also log total operating hours for the control system.
    f. Display service history for the transfer switch. Display source connected hours, to indicate the total number of hours connected to each source. Display number of times transferred, and total number of times each source has failed.
    g. Display information for other transfer switches in the system, including transfer switch name, real time load in KW on the transfer switch, current source condition, and current operating mode.
    h. Display fault history on the transfer switch, including condition, and date and time of fault. Faults to include controller checksum error, low controller DC voltage, ATS fail to close on transfer, ATS fail to close on retransfer, battery charger malfunction, network battery voltage low, network communications error.

C. Internal Controls

1. The transfer switch control system shall be field-configurable for any operating voltage level up to 600VAC. Provide RMS voltage sensing and metering that is accurate to within +/-1 percent of nominal voltage level. Frequency sensing shall be accurate to within +/-0.2 percent. Voltage sensing shall be monitored based on the normal voltage at the site. Systems that utilize voltage monitoring based on standard voltage conditions that are not field-configurable are not acceptable.
2. Transfer switch voltage sensors shall be close differential type, providing source availability information to the control system based on the following functions:

    a. Monitoring all phases of the normal service (source 1) for under voltage conditions (adjustable for pickup in a range of 85 to 98 percent of the normal voltage level and dropout in a range of 75 to 98 percent of normal voltage level).
    b. Monitoring all phases of the emergency service (source 2) for under voltage conditions (adjustable for pickup in a range of 85 to 98 percent of the normal voltage level and dropout in a range of 75 to 98 percent of pickup voltage level).
    c. Monitoring all phases of the normal service (source 1) and emergency service (source 2) for voltage imbalance.
    d. Monitoring all phases of the normal service (source 1) and emergency service (source 2) for loss of a single phase.
    e. Monitoring all phases of the normal service (source 1) and emergency service (source 2) for phase rotation.
    f. Monitoring all phases of the normal service (source 1) and emergency service (source 2) for over voltage conditions (adjustable for dropout over a range of 105 to 135 percent of normal voltage, and pickup at 95-99 percent of dropout voltage level).
    g. Monitoring all phases of the normal service (source 1) and emergency service (source 2) for over or under frequency conditions.
    h. Monitoring the neutral current flow in the load side of the transfer switch. The control shall initiate an alarm when the neutral current exceeds a preset adjustable value in the range of 100-150 percent of rated phase current for more than an adjustable period of 10 to 60 seconds.

3. All transfer switch sensing shall be configurable from a Windows 95, 98, 2000, or NT PC-based service tool, to allow setting of levels, and enabling or disabling of features and functions. Selected functions including voltage sensing levels and time delays shall be configurable using the operator panel. Designs utilizing DIP switches or other electromechanical devices are not acceptable. The transfer control shall incorporate a series of diagnostic LED lamps.
4. The transfer switch shall be configurable to control the operation time from source to source (program transition operation). The control system shall be capable of enabling or disabling this feature and adjusting the time period to a specific value. A phase band monitor or similar device is not an acceptable alternate for this feature.
5. The transfer switch shall incorporate adjustable time delays for generator set start (adjustable in a range from 0-15 seconds); transfer (adjustable in a range from 0-120 seconds); retransfer (adjustable in a range from 0-30 minutes); and generator stop (cool down) (adjustable in a range of 0-30 minutes).
6. The transfer switch shall be configurable to accept a relay contact signal and a network signal from an external device to prevent transfer to the generator service.
7. The control system shall be designed and prototype tested for operation in ambient temperatures from -40C to +70C. It shall be designed and tested to comply with the requirements of the noted voltage and RFI/EMI standards.

8. The control shall have optically isolated logic inputs, high isolation transformers for AC inputs, and relays on all outputs, to provide optimum protection from line voltage surges, RFI and EMI.
9. Transfer switch to be provided with additional contact to be tied into energy management system to signal generator is in run mode.

D. Control Interface

1. The transfer switch will provide an isolated relay contact for starting of a generator set. The relay shall be normally held open, and close to start the generator set. Output contacts shall be form C, for compatibility with any generator set.
2. Provide one set Form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 amps 250 VAC.

2.4 ENCLOSURE

A. Enclosures shall be UL listed. The enclosure shall provide wire bend space in compliance to the latest version of NFPA70. The cabinet door shall include permanently mounted key type latches.

B. Transfer switch equipment shall be provided in a NEMA 1 or better enclosure.

C. Enclosures shall be the NEMA type specified. The cabinet shall provide code-required wire bend space at point of entry as shown on the drawings. Manual operating handles and all control switches (other than key-operated switches) shall be accessible to authorized personnel only by opening the key-locking cabinet door. Transfer switches with manual operating handles and/or non-key-operated control switches located on outside of cabinet do not meet this specification and are not acceptable.

2.5 OPERATION

A. Sequence of Operation

1. Transfer switch normally connects an energized utility power source (source 1) to loads and a generator set (source 2) to the loads when normal source fails. The normal position of the transfer switch is source 1 (connected to the utility), and no start signal is supplied to the genset.
2. Generator Set Exercise (Test) With Load Mode. The control system shall be configurable to test the generator set under load. In this mode, the transfer switch shall control the generator set in the following sequence:

    a. Transfer switch shall initiate the exercise sequence at a time indicated in the exercise timer program, or when manually initiated by the operator.
    b. The transfer switch shall issue a compatible start command to the generator set and cause the generator set to start and run at idle until it has reached normal operating temperature.
    c. When the generator set has reached normal operating temperature or after an adjustable time period (whichever is shorter), the control system shall adjust the generator set output to rated voltage and frequency.

d. When the control systems senses the generator set at rated voltage and frequency, it shall operate to connect the loads to the generator set by opening the normal source contacts, and closing the alternate source contacts a predetermined time period later. The timing sequence for the contact operation shall be programmable in the controller.
e. The generator set shall operate connected to the load for the duration of the exercise period. If the generator set fails during this period, the transfer switch shall automatically reconnect the generator set to the normal service.
f. On completion of the exercise period, the transfer switch shall operate to connect the loads to the normal source by opening the alternate source contacts, and closing the normal source contacts a predetermined time period later. The timing sequence for the contact operation shall be programmable in the controller.
g. The transfer switch shall operate the generator set unloaded for a cool down period, and then remove the start signal from the generator set. If the normal power fails at any time when the generator set is running, the transfer switch shall immediately connect the system loads to the generator set.

3. Generator Set Exercise (Test) Without Load Mode. The control system shall be configurable to test the generator set without transfer switch load connected. In this mode, the transfer switch shall control the generator set in the following sequence:

a. Transfer switch shall initiate the exercise sequence at a time indicated in the exercise timer program, or when manually initiated by the operator.
b. The transfer switch shall issue a compatible start command to the generator set and cause the generator set to start and run at idle until it has reached normal operating temperature.
c. When the generator set has reached normal operating temperature or after an adjustable time period (whichever is shorter), the control system shall accelerate the generator set to rated voltage and frequency.
d. When the control systems senses the generator set at rated voltage and frequency, it shall operate the generator set unloaded for the duration of the exercise period.
e. At the completion of the exercise period, the transfer switch shall remove the start signal from the generator set. If the normal power fails at any time when the generator set is running, the transfer switch shall immediately connect the system loads to the generator set.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify surfaces and areas are ready to receive work.

B. Verify field measurements are accurate and shown on drawings.

C. Verify proper power connections are installed.

D. Proceed with installation only after unsatisfactory conditions are corrected.

E. All wiring shall test free from grounds and shorts.

3.2 FIELD MEASUREMENTS

A. Field verify with exact measurements, the available mounting space for standby power system equipment. Identify deficiencies prior to beginning installation.

3.3 DELIVERY STORAGE AND HANDLING

A. It shall be the responsibility of the installing contractor to receive all standby power system equipment at the job site. Carefully inspect all equipment for damage prior to accepting from the shipping agency. Do not accept shipment if damage is evident.

B. Exercise due diligence in storing, protecting, and moving standby power system equipment. Damaged or worn equipment will not be accepted and will be replaced at no additional cost to the Owner.

3.4 INSTALLATION

A. General:

1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer’s recommendations.
2. Install all fixtures, materials, assemblies and equipment in strict accordance with manufacturer’s recommendations and instructions. Consult manufacturer for all wiring diagrams, schematics, sizes, outlets, etc. before installing.
3. Start of installation shall not begin until areas are broom clean, properly lighted, exterior enclosing walls in place, exterior windows glazed, roof completely installed to prevent weather damage to equipment.

B. Install equipment in locations as indicated on the contract documents. Adjust locations as needed to ensure operability, serviceability, and compliance with all applicable codes and standards.

C. Mount per Section 26 05 29.

D. Installation shall be completely tested prior to start-up. This work includes verification of all field wiring continuity and proper termination of wiring.

E. The contractor shall install the equipment in accordance with final submittals and contract documents. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.

F. Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.

G. Equipment shall be initially started and operated by representatives of the manufacturer.

H. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to final testing of the system.

I. Final Testing:

1. Standby power system supplier shall provide installation and start-up services required to place the complete system into operation.
2. The complete installation shall be tested for compliance with the specification following completion of all site work. Representatives of the manufacturer shall conduct testing, with required fuel supplied by Contractor. The Engineer shall be notified in advance and shall have the option to witness the tests.
3. Installation acceptance tests to be conducted on-site shall include a "cold start" test, a two-hour full load test, and a one step rated load pickup test in accordance with NFPA 110.
4. Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service and observing proper operation of the system for at least 2 hours. Coordinate timing and obtain approval for start of test with site personnel.
5. Test all control functions by simulating conditions.
6. The generator set supplier shall perform a complete operational test on the automatic transfer switch prior to shipping from the factory. A certified test report shall be provided. Equipment supplied shall be fully tested at the factory for function and performance.
7. Factory testing may be witnessed by the owner and consulting engineer. Costs for travel expenses will be the responsibility of the owner and consulting engineer. Supplier is responsible to provide two weeks notice for testing.
8. Test process shall include calibration of voltage sensors.
9. One technician follow-up visit shall be scheduled one month after commissioning for the purpose of verifying satisfactory system operation and making any required final adjustments and repairs.

3.5 OWNER TRAINING

A. The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided as part of the owner training session specified under Standby Engine Generator Set.

B. Provide complete operator training for the Owner’s personnel.

C. Provide two (2) four hour training sessions on consecutive days at times set by the Owner. These should be scheduled as part of the Owner’s pre-occupancy transition training.

D. Provide a video tape training which can be used by the Owner for training new employees. This tape shall be carefully organized and segmented so that training may be given on the complete system, or on specific functions as may be appropriate.

E. Use submitted Operations & Maintenance manuals as reference during this demonstration and tour.

3.6 SPARE EQUIPMENT (NONE)

END OF SECTION 263600

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SECTION 264313 - SURGE SUPPRESSION

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.2 APPLICABLE PUBLICATIONS

A. American National Standards Institute.

B. Institute of Electrical and Electronic Engineers (ANSI/IEEE C62.41.1-2002, C62.41.2-2002, and C62.45-2002).

C. IEEE Std. 1100 “The Emerald Book” Section 8.4.2.5.

D. Canadian Standards Association (CSA).

E. Federal Information Processing Standards Publication 94 (FIPS PUB 94).

F. National Fire Protection Association (NFPA 20, 70, 75, and 78).

G. Underwriters Laboratories UL 1449 most recent edition.

H. The system shall be UL listed as a complete system under UL 1449 Standard for Surge Protection Devices.

I. Underwriters Laboratories UL 96A Lightning Protection Master Label and NFPA 780 – 20kA (In)nominal discharge rating.

J. 2017 NEC 285 – 2020 NEC Article 242

1.3 DESCRIPTION OF WORK

A. Furnish and install a complete and operable surge suppression device as indicated on the drawings and as specified herein.

1.4 RELATED WORK ELSEWHERE

A. Division 26 – Electrical.

1.5 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

B. Manufacturer will provide the following type test documentation for approval:

1. Provide UL-1449, Third Edition documentation showing the unit Voltage Protection Rating (VPR) and all “Engineering Considerations”.
2. Provide third part test documentation showing nominal discharge current of 20kA. Reports will clearly show that tests were performed on a complete device including all necessary fusing, disconnects, and monitoring systems.
3. Provide third part test documentation showing that the unit will survive the specified Short Circuit Current Rating without the need for additional or external fusing.

1.6 OPERATION & MAINTENANCE MANUALS

A. Submit Operations & Maintenance Manuals in accordance with Section 26 05 04.

1.7 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. The following shall be provided in addition to items listed above.

1. Factory Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer’s products that are similar in material, design, and extent to those indicated for this Project.
2. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
3. Manufacturer’s Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.
4. Manufacturer must carry replacement parts.
5. Manufacturer shall have a minimum of five years experience in applying SPD products in the application specified for this project.

1.8 WARRANTY

A. The manufacturer shall provide a full ten-year parts and five-year labor warranty for service entrance units and a five year parts warranty for branch circuit units. This warranty shall be from date of shipment against any part failure when installed in compliance with manufacturer's written instructions, UL listing requirements, and any applicable national or local electrical codes.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, and repair parts cost.

C. Due to the sensitive nature of this type of equipment, the Contractor agrees that warranty service shall be completed promptly, and that where necessary, premium freight (i.e. Fed-Ex or equal) will be used to obtain replacement parts. Service response requirements shall include the following:

1. Twenty-four (24) hour phone number.
2. Ability to restore functionality within eight (8) hours after notification on a twenty-four (24) hour basis.

D. 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.

PART 2 - PRODUCTS

2.1 SERVICE ENTRANCE EQUIPMENT

A. Approved Manufacturers: Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are as follows, no substitutions

1. Current Technology – SL Series
2. Raycap – Rayvoss Series

B. The equipment's minimum surge current capacity shall be 200kA per phase (L-N plus L-G) and 100 kA per mode (L-N, L-G, L-L and N-G).

C. The system shall be constructed using multiple surge current diversion modules utilizing metal oxide varistors (MOV) and high capacity thermal eletrodes ensuring max surge current capacity can pass through the SPD without degraation or failure. Use of gas tubes, silicon avalanche diodes or selenium cells are unacceptable unless documentation from a nationally recognized laboratory demonstrates the surge current capacity of all dissimilar components at all surge current levels.

D. The service entrance SPD will be capable of surviving 600 IEC, 10x350µs waveforms of 5kA impulses without failure or degradation of original performance characteristics of more than 5%

E. All primary transient paths shall utilize copper wire, aluminum bus bar and lugs of equivalent capacity to provide equal impedance interconnection between phases. No plug- in module or components shall be used in surge carrying paths.

F. Each protection module shall have a visual indicator that signifies that the protection circuitry is on line. The unit shall not be taken off line to verify integrity of system. Redundant status indicators shall be mounted on the front of the door that monitors the system protection circuitry.

G. Protection modes: The SPD shall provide Line to Neutral (L→N)(Wye), Line to Ground (L→G)(Wye or Delta), Line to Line (L→L)(Delta) and Neutral to Ground (N→G)(Wye) protection.

H. UL 1449 Listed Voltage Protection Ratings (VPRs) shall not exceed the following:

VOLTAGE	L-N	L-G	N-G	MCOV
208Y/120	800V	800V	800V	150V

I. The SPD shall be a UL Type 2 device with a 20kA I-nominal rating.

J. Service Conditions: Rate surge protective device for continuous operation under the following conditions, unless otherwise indicated:

1. MCOV: Maximum Continuous Operating Voltage of 115% or greater.
2. Operating Temperature: 30 to 120 degrees F.
3. Humidity: 0 to 85 percent, non-condensing.
4. Altitude: Less than 20,000 feet above sea level.

K. Equipment shall provide the following advanced monitoring features:

1. Integral touch screen color LCD display providing real-time system RMS voltage, current, frequency, power factor, kW, kVAR, and kVA.
2. Event count with time & date stamp showing surges, sags, swells, outages, and over/under frequency.
3. User settable alarms and thresholds.
4. Embedded webpage or SNMP for remote monitoring capable of charting and downloading reports.

2.2 BRANCH PANEL EQUIPMENT

A. Approved Manufacturers: Subject to compliance with requirements of the Contract Documents, acceptable manufacturers are as follows, no substitutions

1. Current Technology – TG Series
2. Raycap – RSE Series

B. The equipment's minimum surge current capacity shall be 100kA per phase (L-N plus L-G) and 50 kA per mode (L-N, L-G, L-L and N-G).

C. The system protection shall contain a technology that utilizes a symmetrical array of metal oxide varistors (MOV) in a stacked formation.

D. Protection modes: The SPD shall provide Line to Neutral (L→N)(Wye), Line to Ground (L→G)(Wye or Delta), Line to Line (L→L)(Delta) and Neutral to Ground (N→G)(Wye) protection.

E. UL 1449 Listed Voltage Protection Ratings (VPRs) shall not exceed the following:

VOLTAGE	L-N	L-G	N-G	MCOV
208Y/120	600V	600V	600V	150V

F. The SPD shall be a UL Type 2 device with a 20kA I-nominal rating.

G. Service Conditions: Rate surge protective device for continuous operation under the following conditions, unless otherwise indicated:

1. MCOV: Maximum Continuous Operating Voltage of 115% or greater.
2. Operating Temperature: 30 to 120 degrees F.
3. Humidity: 0 to 85 percent, non-condensing.
4. Altitude: Less than 20,000 feet above sea level.

H. Equipment shall provide the following monitoring features: dry contacts, audible alarm with disable switch and surge counter.

2.3 CONNECTIONS

A. All parallel connections to the SPD shall be installed per the manufacturers recommendations and shall be kept as short as possible.

2.4 ENCLOSURE

A. The enclosure shall be NEMA 12 UL94-5V rated or metal at the branch panel. All panels shall be NEMA rated for the location.

2.5 UNIT STATUS INDICATORS

A. The unit shall have an integral status circuit that monitors the operational status of all modes of protection, including Line to Neutral, Line to Ground and Neutral to Ground. No manual testing is required to confirm the integrity of the suppression and filter systems. If the unit does fail, the LED will go out.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify surfaces and areas are ready to receive work.

B. Verify field measurements are accurate and shown on drawings.

C. Verify proper power connections are installed.

D. Proceed with installation only after unsatisfactory conditions are corrected.

3.2 FIELD MEASUREMENTS

A. Verify feeder is less than 5 feet from main bus bar for remote mounted units.

3.3 DELIVERY, STORAGE & HANDLING

A. Receive, sign for, and store all equipment in this section.

B. Maintain original quality and condition of equipment while it is in storage.

3.4 INSTALLATION

A. General:

1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer's recommendations.
2. Install all materials, assemblies and equipment in strict accordance with manufacturer's recommendations and instructions. Consult manufacturer for all wiring diagrams, schematics, sizes, outlets, etc. before installing.
3. Start of installation shall not begin until areas are broom clean, properly lighted, exterior enclosing walls in place, exterior windows glazed, roof completely installed to prevent weather damage to equipment.

B. Service Entrance:

1. The service entrance SPD will be mounted externally to the service entrance equipment. Mount the SPD to minimize phase and neutral lead lengths. Avoid sharp cable bends and twist the phase conductors around the neutral conductor when possible. The SPD will either be wired through a 60A, 3-pole breaker provided by the service entrance equipment, or if the breaker is not available or practical, shall be cabled directly to the equipment bus bar. In this case, an integral, non-fused disconnect will be provided in the SPD enclosure. See drawing details for additional information.
2. The specified service entrance /switchboard/ switchgear system shall be installed with the shortest lead length possible not to exceed five (5') electrical feet from the power conductor(s) it is protecting, must have a grounding of 25 Ohms (NEC Article 250.56) or less.

C. Branch Panel:

1. The branch panel entrance SPD will be mounted externally to the panelboard as close as possible to the panelboard neutral lug. A 20A, 3-pole breaker will be located as close as possible to the SPD location and will serve as the maintenance disconnect for the SPD. The specified branch panelboard system shall be installed with the shortest lead length possible not to exceed a foot and half (1.5') electrical feet from the power conductor(s) it is protecting, must have a grounding of 25 Ohms (NEC Article 250.56) or less and shall avoid any unnecessary or sharp bends.

D. Cleaning:

1. Prior to turning the system over to the Owner, the system shall be physically cleaned.
2. All appearance defects shall be carefully and professionally touched up so that the equipment is in “factory new” condition.
3. At the completion of the work, remove from the building and the premises all rubbish and debris resulting from the work.

3.5 OWNER TRAINING

A. Provide complete operator training for the Owner’s personnel.

3.6 SPARE EQUIPMENT (NONE)

END OF SECTION 264313

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SECTION 265113 - INTERIOR LIGHTING FIXTURES

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.2 APPLICABLE PUBLICATIONS

A. Conform to requirements of current ANSI/NFPA 70 - National Electric Code.

B. Conform to current Underwriters Laboratories (UL) Specifications and Standards.

C. Conform to Wisconsin Administrative Code, SPS 363.

D. Conform to National Fire Protection Association NFPA 101.

E. Conform to American National Standards Institute ANSI C 82.11-1993

F. Conform to current National Electrical Manufactures Association Standards.

1.3 DESCRIPTION OF WORK

A. Furnish and install a complete interior lighting system as required on the drawings and as specified herein.

1.4 RELATED WORK ELSEWHERE

A. Division 09: Finishes

B. Division 23: Heating, Ventilation and Air Conditioning.

C. Division 26, 27, and 28: Electrical

1.5 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

B. The following information shall be submitted in addition to items listed above:

1. Submit color samples as requested.
2. 2” x 2” color sample of specialty fixtures specified (all fixtures, with the exception of all lay-in or industrial fixtures.

3. Fixtures specified as “RAL color to be determined” shall:

    a. Include one RAL color swatchbook equal to PPG ENVIRPCRON Powder coatings Classic RAL Color Deck with submittals.
    b. RAL color choice will be returned with submittals.
    c. One 2” x 2” metal color sample chip of approved RAL color shall be submitted within 30 days of return of submittals containing RAL color choice. Chip shall be labeled with RAL number.
    d. Submittal documents accompanying RAL 2” x 2” metal color sample chip will be returned with notification of acceptance or rejection. Chip shall be retained for records.

4. Fixtures with Specified RAL colors shall:

    a. Include one 2” x 2” metal color sample chip of approved RAL color shall be submitted within 30 days of return of submittals containing RAL color choice. Chip shall be labeled with RAL number.
    b. Submittal documents accompanying RAL 2” x 2” metal color sample chip will be returned with notification of acceptance or rejection. Chip shall be retained for records.

1.6 OPERATION & MAINTENANCE MANUALS

A. Submit Operations & Maintenance Manuals in accordance with Section 26 05 04.

1.7 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. All materials, equipment and parts shall be new and unused of current manufacture.

C. Provide all necessary accessories required for a complete and operable system.

D. Test fixtures for proper operation and make all ready for use by Owner.

1.8 WARRANTY

A. Lighting fixtures shall be warranted for a period of not less than 1 year from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, and repair parts cost.

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.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials and equipment shall be new (less than 1 year old when turned over to the Owner).

2.2 FIXTURES AND COMPONENTS

A. Each bidder shall make his own count of all fixtures of the types indicated on the fixture schedule and they shall be furnished as outlined hereunder.

B. Basic catalog number only is given herein for fixtures; plaster rings, fixture ends or caps, suspension units, furnish mounting brackets and/or all other auxiliary parts necessary for a complete installation. Fixture shall be furnished as required, for a full and complete installation, even though not specifically called out on plans.

C. Should any parts of the fixtures be found to be bent or not in accord with their designed position, adjust, repair or replace at once the affected items required.

2.3 DRIVERS

A. All drivers to be universal voltage.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine each luminaire to determine suitability for location specified.

3.2 FIELD MEASUREMENTS

A. Verify that field measurements are as shown on drawings.

3.3 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for, and store all equipment in this section.

B. Maintain original quality and condition of equipment while it is in storage.

3.4 INSTALLATION

A. General:

1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer's recommendations.
2. Install all materials, assemblies and equipment in strict accordance with manufacturer's recommendations and instructions. Consult manufacturer for all wiring diagrams, schematics, sizes, outlets, etc. before installing.
3. Start of installation shall not begin until areas are broom clean, properly lighted, exterior enclosing walls in place, exterior windows glazed, roof completely installed to prevent weather damage to equipment.
4. Check and confirm ceiling material, recessing space and suspension system with General contractor before releasing the order for any recessed fixtures.
5. Type of ceiling material and suspension system must be submitted with fixture order to ensure delivery of proper fixtures.
6. Approval of fixture drawings by the Electrical Engineer shall not relieve this section from responsibility of ceiling confirmation.
7. Clean electrical parts to remove conductive and deleterious materials.
8. Remove dirt and debris from enclosure.
9. Clean photometric control surfaces as recommended by manufacturer.
10. Clean finishes and replace damaged equipment.
11. All fixtures to be supported from structural system, not from ceiling material.

    a. All fixtures to be supported at minimum of 4 feet-0 inches on center.
    b. All tees supporting fixtures to be secured directly to the structural system.
    c. Intermediate tees shall not be used for mounting fixtures.
    d. If fixtures occur between structural tees, fixture supports shall be installed by spanning structural tees from above, or by suspending a channel support above ceiling from building structure.

12. Recessed lay-in and non-recessed grid mounted lighting fixtures:

    a. Where lay-in light fixtures are provided, the fixture shall be securely fastened to the ceiling framing members by mechanical means; such as bolts, screws, or rivet clips identified for use with the type of ceiling framing members and fixtures being used.
    b. Grid mounted fixtures shall be mounted in the grid and attached to the grid system per NEC.
    c. Separate mounting shall be provided to the ceiling structure above.
    d. Provide a minimum of two supports per fixture per NEC.

13. Pendant suspended luminaires:

    a. All stem mounted luminaires shall be suspended with swivel hangers.
    b. Install suspended luminaires using pendants/stems supported from swivel hangers.
    c. Provide pendant/stem length required to suspend luminaire at indicated height.

14. Aircraft cable suspended luminaires

    a. All aircraft cable luminaires to be suspended with swivel hangers.

b. Install aircraft cable suspended luminaires using aircraft cable supported from swivel hangers.
c. Provide aircraft cable length required to suspend luminaire at indicated height.

15. Recessed luminaries:

a. Locate recessed ceiling luminaires as indicated on ceiling plan.
b. Relocate light fixtures as necessary and coordinate with other mechanical trades.
c. Coordinate installation in the field, where necessary.
d. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
e. Install clips to secure recessed grid-supported luminaires in place and separate support wires for each fixture.
f. Where recessed fixtures occur in tile ceiling, notify the ceiling contractor so fixture and tile arrangements can be coordinated.
g. Install recessed luminaires to permit removal from below.

16. Surface mounted luminaries:

a. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prohibit movement.

17. Lighting fixtures installed in areas where there are not suspended ceilings:

a. In areas where lighting fixtures are installed where there are not suspended ceilings furnish all mounting hardware.
b. Continuous fixtures:

1) In areas where lighting fixtures are mounted end-to-end in ceiling joist area, furnish support strut to solidly support the fixtures.
2) Support strut may be B-line, Kindorf or equal.
3) Strut shall be supported 8' on center using pendant hangers with swivels mounted on 4" square boxes.

18. Mounting hardware painting:

a. Mounting hardware to be installed prior to the ceiling being painted.
b. If it is not installed prior to that time, paint the support hardware.

19. Special color requirements:

a. Refer to fixture schedule to determine if there are special color requirements for the mounting hardware and lighting fixtures other than the ceiling finish.

20. Clearance heights:

a. Lighting fixtures shall be mounted to maintain maximum head clearance height and that the bottom of the fixtures shall be even with the bottom of the ceiling joists.

21. Mounting locations:

a. The fixtures shall be mounted between the joists unless otherwise shown on the floor plans.
b. If fixtures are mounted perpendicular to joist, attach fixtures to the bottom of the joist and furnish steel support struts to the bottom of the joists for fixture support.

22. Individual fixtures:

a. In the ceiling joist area, individual fixtures shall be supported using pendant hangers with swivels mounted on 4" square boxes.
b. Fixtures shall be fed through one pendant end.

23. Flat ceiling spaces:

a. The fixtures shall be mounted tight to the ceiling unless it is required to adjust the fixture height because of mechanical equipment interference.
b. If required to adjust the fixture height because of mechanical equipment interference, support the fixtures using pendant hangers.

24. Wire Guards:

a. Furnish wire guards for all open strip or industrial fixtures.

25. Mechanical Rooms:

a. The light fixtures in the mechanical rooms are shown to indicate number of fixtures only.
b. Locate the lighting fixtures to coordinate with the mechanical equipment installation.
c. If required, these fixtures may be supported using chain with a cord connection.
d. If fixture cannot be mounted on the ceiling, lighting fixture shall be mounted on the wall using an adjustable wall bracket.

B. Install accessories furnished with each luminaire.

C. Connect luminaires using flexible conduit.

D. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

E. Bond products and metal accessories to branch circuit equipment grounding conductor

F. Fixtures not to be used as a raceway.

G. Cleaning:

1. Prior to turning the system over to the Owner, the system shall be physically cleaned.
2. All appearance defects shall be carefully and professionally touched up so that the equipment is in “factory new” condition.
3. At the completion of the work, remove from the building and the premises all rubbish and debris resulting from the work.

H. Final Testing:

1. Operate each luminaire after installation.
2. Confirm codes are met regarding daylighting and dual level controls.
3. Confirm light controls properly operate intended fixtures.

3.5 OWNER TRAINING

A. Provide minimum of one hour training on luminaire operation and component replacement.

3.6 SPARE EQUIPMENT

A. 10% Spare LED lamp modules of each fixture type, minimum 1.

B. 10% spare LED drivers of each fixture type, minimum 1.

END OF SECTION 265113

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SECTION 265629 - EXTERIOR LIGHTING FIXTURES

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.2 APPLICABLE PUBLICATIONS

A. Conform to requirements of current ANSI/NFPA 70 - National Electric Code.

B. Conform to current Underwriters Laboratories (UL) Specifications and Standards.

C. Conform to ACI recommendations.

1.3 DESCRIPTION OF WORK

A. Furnish and install complete and operable exterior lighting system as indicated on the drawings and as specified herein.

B. Supply and install all concrete fixture bases.

1.4 RELATED WORK ELSWHERE

A. Division 02: Site Work

B. Division 04: Masonry

C. Division 26, 27, and 28: Electrical

1.5 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

B. The following information shall be submitted in addition to items listed above:

1. 2” x 2” color samples of fixtures specified if color is not white, black or bronze.
2. Fixtures specified as “RAL color to determined” shall:

    a. Include one RAL color swatchbook equal to PPG ENVIRPCRON Powder coatings Classic RAL Color Deck with submittals.
    b. RAL color choice will be returned with Submittals.

c. One 2” x 2” metal color sample chip of approved RAL color shall be submitted within 30 days of return of submittals containing RAL color choice. Chip shall be labeled with RAL number.
d. Submittal documents accompanying RAL 2” x 2” metal color sample chip will be returned with notification of acceptance or rejection. Chip shall be retained for records.

3. Fixtures with specified RAL colors shall:

a. Include one 2” x 2” metal color sample chip of approved RAL color shall be submitted within 30 days of return of submittals containing RAL color choice. Chip shall be labeled with RAL number.
b. Submittal documents accompanying RAL 2” x 2” metal color sample chip will be returned with notification of acceptance or rejection. Chip shall be retained for records.

1.6 OPERATION & MAINTENANCE MANUALS

A. Submit Operations & Maintenance Manuals in accordance with Section 26 05 04.

1.7 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. All materials, equipment and parts shall be new and unused of current manufacture.

C. Provide all necessary accessories required for a complete and operable system.

D. Store Lighting Fixtures and accessories in original cartons and in clean dry space; protect from weather and construction traffic.

1.8 WARRANTY

A. Equipment shall be warranted for a period of not less than 1 year from the date of commissioning against defects in material and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

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.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials and equipment shall be new (less than 1 year old when turned over to the Owner).

2.2 FIXTURES AND COMPONENTS

A. Each bidder shall make a count of all fixtures of the type indicated on the fixture schedule and they shall be furnished as hereunder.

B. Basic catalog numbers only are given herein for fixtures. Provide auxiliary parts necessary for a complete installation.

C. Fixtures shall be furnished as required, for a full and complete installation, even though not specifically called out on plans.

D. Should any parts of the fixture be found to be bent or not in accord with their designed position, adjust, repair or replace at once the affected items required and subject to Architect’s approval.

E. Provide all equipment, wiring and concrete pole bases.

F. Exterior pole installation shall include a pole base cover. This pole base cover shall be included and installed for all exterior lighting and poles whether or not specifically called for in the fixture schedule.

G. To provide for future flexibility and control of exterior lighting, the site plan drawings indicate three conductors to each of the poles.

H. All exterior pole mounted lighting shall have fuses in each of the current carrying wires. Fuses shall be watertight fuse arrangement, Buss type HEB or equal.

2.3 FIXTURE BASES

A. Be responsible for furnishing and installation of all concrete bases. If not qualified in the installation of concrete bases, employ the services of a contractor who is qualified in the installation of concrete bases.

B. Refer to the drawings, plans and details for pole base locations and construction details.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine each luminaire to determine suitability for lamps specified.

3.2 FIELD MEASUREMENTS

A. Field verify exact location of all poles and ground mounted fixtures. Adjust to accommodate field conditions.

B. Coordinate with landscape architecture.

C. Coordinate exact pole location with site surveyor.

3.3 DELIVERY, STORAGE AND HANDLING

A. Receive, sign for and store all equipment in this section.

B. Maintain original quality and condition of equipment while it is in storage.

3.4 INSTALLATION

A. General:

1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer’s recommendations.
2. Install all fixtures, materials, assemblies and equipment in strict accordance with manufacturer’s recommendations and instructions. Consult manufacturer for all wiring diagrams, schematics, sizes, outlets, etc. before installing.

B. Cleaning:

1. Prior to turning the system over to the Owner, the system shall be physically cleaned.
2. All appearance defects shall be carefully and professionally touched up so that the equipment is in “factory new” condition.
3. At the completion of the work, remove from the building and the premises all rubbish and debris resulting from the work.

C. Fixture Bases:

1. Bases shall be installed per ACI installation specifications. The following shall be adhered to:

    a. For round bases, the base shall not be out of round more than 1"; i.e. for a 24" base, maximum diameter 24.5", minimum diameter, 23.5".
    b. Bases shall be vertically plum within 1/2 bubble.
    c. Fixture bases shall be in line with sidewalks, roadways, or building lines; whichever applies.
    d. Bases shall be installed such that the center line over all the bases is not more than 1" beyond a site line of all the bases.
    e. If there is a question as to the site line, it should be brought to the Architect's attention for determination.
    f. Fixture base details generally indicate the height of the top of the base above finished grade.

g. Finished grade is established as the sidewalk or roadway that is being lighted using the exterior fixtures.
h. If there is a question as to what established grade height should be used, it should be brought to the Architect's attention for determination.

2. For round bases where sonotube or similar cardboard form is used, strict adherence to the tube manufacturer's specifications shall be followed. These shall include, but are not limited to:

a. Tubes shall not be stored on their side.
b. Tubes must be protected from moisture at all times.
c. If any tube is found to be delaminated prior to the concrete pour, it shall be removed and replaced with a new tube.

3. A releasing agent shall be sprayed on the sonotube prior to installation so that the tube can be easily removed from the concrete base.
4. Sonotube shall be removed to below grade as soon as possible after concrete installation.
5. Any excessive pockets in the concrete base shall be patched as per ASCI standard practice.
6. Concrete base shall be rubbed to provide a smooth finish.
7. The concrete shall be vibrated during installation to remove any air pockets.
8. A rod shall be pushed down around the entire perimeter of the form to remove air pockets from forming between the sonotube and the concrete.

D. Exterior Sign & Building Wash Light Fixture

1. Where ground mounted sign and building wash light fixtures are indicated on the plans, assume the following:

a. Fixtures shall be installed on a temporary basis using temporary power connections. Fixtures shall be provided with portable type bases.
b. Flood light type fixtures shall be provided with Barn Door type shutters unless noted.
c. Fixtures shall be night aimed.
d. Fixtures shall be installed permanently after proper aiming is complete.

E. Exterior Light Pole:

1. Unless specified otherwise, all equipment, wiring and concrete pole bases shall be provided.
2. Concrete bases shall be installed as shown using a double nut anchor bolt system as follows:

a. After the concrete base is poured the first nut is installed on the anchor bolt and the pole base is set on this nut.
b. The second nut is placed on the top of the pole base plate.
c. The nuts are then used to properly level the pole.
d. Once the pole is leveled, the nuts shall be tightened and the void between the pole base and the concrete base shall be grouted.
e. This grouting shall include a drain gutter sloping away from the pole.
f. Exterior pole installation shall include a pole base cover.

g. A pole base cover shall be included and installed for all exterior lighting.

F. Exterior Lighting Circuitry:

1. Exterior building lighting is shown as being connected to either a photo-eye on timeclock off or photo-eye on photoeye off.

G. Start-Up and Testing:

1. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.5 OWNER TRAINING

A. Provide minimum of one hour training on luminaire operation and component replacement.

3.6 SPARE EQUIPMENT

A. 10% Spare LED lamp modules of each fixture type, minimum 1.

B. 10% spare LED drivers of each fixture type, minimum 1.

END OF SECTION 265629

SECTION 271000 -STRUCTURED CABLING SYSTEM

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.2 APPLICABLE PUBLICATIONS

A. TIA/EIA 568-B.1 – Commercial Building Telecommunications Cabling Standard, Part 1: General requirements.

B. TIA/EIA 568-B.2. Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted Pair Cabling Components.

C. TIA/EIA 568-B.3 Optical Fiber Cabling Components Standard.

D. TIA/EIA-569-A - Commercial Building Standards for Telecommunications Pathways and Spaces.

E. TIA/EIA-606 - Documentation.

F. TIA/EIA-607 - Commercial Building Bonding and Grounding Requirements.

G. Definitions:

1. MC: Main Communications Closet.
2. TC: Telecommunications Communications Closet.
3. MDF: Main Distribution Frame - this term is used interchangeably with MC.
4. IDF: Intermediate Distribution Frame - this term is used interchangeably with TC.
5. Access point: The outlet point for wireless LAN connection
6. Backboard (normally called a backplane): A panel, wood or metal, used to mount termination hardware, on the wall that is adjacent to the relay rack. The plywood used for the backboard shall be fire rated ¾” plywood, painted off white.
7. Backbone Cable: A facility installed between different distribution points for the purpose of connecting system distribution points.
8. Back/Outlet Box: This box is used for terminating outlets.
9. Cable Labeling System: The printed labeling system that allows labeling of each telecommunications room (TR), all relay racks, patch panels, backbone and horizontal cables (this includes the grounding bus throughout the facility) and conduit runs.
10. Cable Tray: A mechanism that allows cable to be managed.
11. Communications Pole (also called Power Pole): A raceway that provides a patch from the ceiling to the furniture or floor. This pole might be dedicated or shared between the low voltage and the electrical services.
12. Conduit Run: Multiple sections of conduit placed to run cables inside. Typically a conduit run is when you cannot see the other end from the beginning.

13. Conduit Stub: A section of conduit place to run cables up (vertically) to an exposed cable route in the ceiling area. The conduit stubs sometimes run down through the floor to the ceiling area below or to a floor jack.
14. Contractor, Electrical (EC): The contractor that is awarded the bid or contract for described work in Division 26.
15. Cross-Connect: A facility enabling termination of cables and their inter-connection.
16. Cut-In: Creating a pathway, using the wall cavity as the pathway. Used when there is no conduit in place and raceway is not required vertically up the wall.
17. Exposed: This is any location that can be seen from an occupied space when the project is complete. The exceptions will be noted in this specification.
18. Entrance Facility: This area provides the entrance point for the communication services that enter the facility from the AP or the cable service provider. Lightning protection shall be installed, unless otherwise noted. This is where the outside cable type shall convert to inside cabling, unless otherwise noted. The outside cabling can be extended to the equipment room in metal conduit. It is recommended, however not required, that the lightning protection be installed as soon as the cable enters the building. The entrance facility may be shared with other services. The lightning protection shall be grounded to the building main ground (this can be done by attaching to the TMGB).
19. Firestop: Specialty material to re-establish a fire rated barrier. The material used is either cementitious or elastomeric.
20. Ground Busbar: The bar that is installed to attach the grounding conductors to. The one that is attached to the grounding electrode via a bonding conductor, typically located in the electrical switch room. Then a TBB is attached to the TMGB and allows all of the TGB's to be grounded. The one that is installed in all of the TR's is a telecommunications busbar (TGB).
21. Ground Conductor(s): The conductor that provides ground to the main grounding system, at the electrical panels is called the bonding conductor (BC). The conductor that connects the telecommunications room (TR's) back to the telecommunication main grounding bus (TMGB) is called the telecommunication bonding backbone (TBB). The grounding backbone between the TR's is called the telecommunication bonding backbone interconnecting bonding conductor (TBBIBC).
22. Horizontal Cabling: The cable used to carry the information from the workstation or end device to the least significant distribution point. For the voice and data this will be the telecommunications room. The paging, security, and CATV will be where distribution points are; normally this is in the equipment room or telecommunication room or equipment room.
23. Installer: Contractor installing the low voltage structured cabling and associated hardware.
24. J-Box: the boxes used to limit or extend distances within a conduit run or horizontal raceways. This box will be required to have the appropriate blank covers installed. The size is determined by the application and the guidelines in the TIA/EIA cabling standards.
25. J-Hook: A support device that is attached to the building structure and used to support structure cabling. The device is shaped like a J and the cables are laid in the open section of the J. There will be a retainer installed on all j-hooks.
26. Ladder Rack: A similar device to a cable tray, however more open elements. The ladder rack is usually installed where there is a high density of cables and accessibility is higher than normal.
27. Office Furniture: The landscape furniture used in place of fixed wall offices. Sometimes referred to as cubicle furniture.
28. Pathway: A vertical and horizontal path, used to place telecommunication cable inside of it.

29. Plenum: A compartment or chamber that is used as part of the air distribution system and is connected with one or more air ducts. Due to the airflow through this chamber, the cable and other materials used in this chamber are required to have a higher fire rating. Typically this airflow is the return airflow path.
30. Power Pole: A raceway that provides a path from the ceiling to the furniture or floor. This pole might be dedicated or shared between the low voltage and the electrical services. If the access pole is a dedicated pole for communication cables, it is sometimes referred to as a communication pole.
31. Pull Cord/Wire: Cord placed in a cable path to pull wire through that same path.
32. RCDD: Registered Communication Distribution Designer. A certification provided by BICSI to individuals that have met criteria via education and testing to be certified to design telecommunication systems.
33. Service Cable Path: The service cable path is a route that allows a minimum of 10' of spare cable provided at the distribution point for the purpose of having spare cable for servicing the structure. This cable will be managed by support hardware as designated by the drawings provided. (There shall not be any service cable left at the station end other than the 6" to 10" left after the cable is terminated.)
34. Station Outlet: A device placed at the end of the horizontal cable to terminate the horizontal cable and connect the network equipment in the work area.
35. Telecommunications Contractor (TC): The contractor that is awarded the bid or contract for this work will include all the work as described in this specification, excluding the EC specified work.
36. Telecommunications Utility: The telecommunications utility will bring their services into the equipment room as designated on the floor plans.
37. Testing: Qualifying the cable for the necessary parameters described. The testing requires electronic and hardcopy of the test results. Sometimes referred to as Acceptance Testing.
38. Utility Pole: A raceway that provides a path from the ceiling to the furniture or floor. This pole might be dedicated or shared between the low voltage and the electrical services.
39. Work Area Outlet: A device placed at the end of the horizontal cable to terminate the horizontal cable and connect the network equipment in the work area.

1.3 DESCRIPTION OF WORK

A. Furnish and install a complete and operable data cabling system and television distribution system as indicated on the drawings and as specified herein to include, but not be limited to: cabling, devices, racks, and cross connects.

B. Mount and connect owner furnished wireless access points (WAP's) in locations as indicated on plans as "WAP". Furnish and install data cables to this location. Mounting hardware to be supplied by owner. Assume all data outlets shown with WAP on drawings will require a WAP to be mounted. Provide male end on all WAP device outlets shown at WAP location and terminate end in data closet on standard patch panel. Coordinate WAP IP addresses prior to installation with owner IT Vendor.

C. Provide and install data cabling, patch panels, devices, termination and testing for IP security camera system and door access control system per plans. All security camera and door access control systems will be furnished and installed by others. This contractor must provide Cat 6 cabling, patch panels, termination, testing, labeling, and cable supports as indicated on plans.

Meet with security camera and door access control system vendors to coordinate cabling locations and termination requirements.

D. Division 26 contractor to include all Division 27 work in their bid.

1.4 RELATED WORK ELSEWHERE

A. Division 26, 27, and 28 – Electrical.

1.5 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

B. The following information shall be submitted in addition to items listed above:

1. Wiring diagram indicating wire size and type for each individual piece of equipment.
2. Complete riser diagram indicating all equipment and interconnecting components with indication of location of each device.
3. Complete front elevation drawing of equipment rack and exact component layout within rack.
4. All drawings must be in CAD format.
5. Cable listing for each cable installed. Indicate in spreadsheet format showing room location, head-end location, and exact labeling. Provide on each end of each outlet.
6. Reduced size floor plan drawing (11" x 17"), showing building floor plan and location of all data outlets. Each of the rooms shall be numbered and the approximate location of each data outlet shall be shown. Prior to beginning that, determine if the owner has an existing number plan sequence in place, and if so, he shall use that numbering system for this project. Include such numbering system on his submittal data.

    a. Determine the numbering method for each of the outlets. As an example; a typical space which consists of five data outlets, the suggested format is to assign a cable number (1, 2, 3, 4, etc.) for each of the data outlets or a letter (A, B, C, D, etc.).

7. As a part of the shop drawing documentation, cable numbers, data outlet numbers, and patch panel jack numbers must be assigned and shown.

1.6 OPERATION & MAINTENANCE MANUALS

A. Submit Operations & Maintenance Manuals in accordance with Section 26 05 04.

B. The following information shall be submitted in addition to the items listed above:

1. Wiring diagram indicating wire size and type for each individual piece of equipment.
2. Complete riser diagram indicating all equipment and interconnecting components with indication of location of each device.
3. Complete front elevation drawing of equipment rack and exact component layout within rack.
4. Provide copy of written warranty.

5. Complete test reports for fiber optic cable. Provide a fiber test form which includes the following:

    a. Date and time of:

        1) Fiber installation.
        2) Fiber termination.
        3) Testing.

    b. Testing equipment used information including:

        1) Make.
        2) Model.
        3) Date of calibration.

    c. Name of person performing test and the installers.
    d. dB loss of each connector installed.
    e. dB loss of each fiber segment.
    f. End to end attenuation.
    g. Optical Time Domaine Reflectometer (OTDR) Signature trace.
    h. Cable shall be tested at the following frequencies:

        1) 850 nm.
        2) 1300 nm.

6. Complete test report for all cabling. Provide test form which includes the following:

    a. Date and time of:

        1) Cable installation.
        2) Cable termination.
        3) Testing report.

    b. Testing equipment used information including:

        1) Make.
        2) Model.
        3) Date of calibration.

    c. Name of person performing test and the installers.
    d. Provide in spreadsheet format. Cable number with test reporting of cable length at near-end crosstalk and attenuation. Also indicate room number of each jack.

7. All cable shall be tested to comply with the standards that are set forth in EIA/TIA TSB 67: Transmission Performance Specifications for Field Testing of Unshielded Twisted Pair Cabling Systems. It is assumed that testing will be done for the basic length of installed horizontal cable 90', length.
8. At each pair of each horizontal feeder cable shall test free of shorts within the pairs. Each pair shall be tested per the schedule listed in appendix 1. Cable length, in feet, shall be tested within 4% of accuracy. All testing shall be done using a cable testing unit that complies with the standards as set forth in TSB 67.

1.7 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04 [Section 26 05 00].

B. Ensure all cables are less than 300 feet in length. Install cables in the shortest possible manner to ensure less than 300 feet is maintained.

C. A single contractor, who has at least five (5) year experience in furnishing similar data, voice, and video systems, shall supply all specified equipment and services.

D. Installation of these components shall be performed by a Contractor experienced in data and communication system installations. Supervisors and installers assigned to the installation of any components related to the systems including in this specification shall be Building Industry Consulting Services International (BICSI) Registered Cabling Installers, Technician Level. BICSI certification documentation shall be made available to Owner/Engineer upon request.

E. A contractor may use (2) non-BICSI installers or each BICSI Technician Level Registered Cabling Installer working on site. BICSI TL-RCI must be on-site supervising the non-BICSI installers. No remote supervision is allowed.

F. As an alternative to the BICSI Technician Level certification requirements in items D and E above, NECA-IBEW Basic Voice, Data, and Video Apprentices may be used. Supervisors and installers must have completed the apprenticeship program; current enrollment is not sufficient.

1.8 WARRANTY

A. The data cabling system and labor for installation shall be provided with a minimum 10-year warranty from the cable manufacturer. This warranty shall cover material and workmanship.

B. The cable installed shall be a certified integrator, and shall provide cable manufacturer certified outlet components, such that the entire system is certified for the 10-year warranty. Provide a letter of verification as a part of the submittal drawings indicating that the warranty will be provided. Failure to provide this letter will cause submittal to be rejected and will require resubmittal.

C. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, and repair parts cost.

D. Submit a written warranty executed by the installer agreeing to repair or replace any data or phone cabling that fails within the warranty period.

E. During the guarantee period there shall be no charges to the Owner for service calls for guarantee work. However, when service work is required to repair items damaged by neglect, misuse, or vandalism, costs shall be reimbursed to this Contractor.

F. 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.

PART 2 - PRODUCTS

2.1 UTP DATA CABLE

A. Outlet cables: All data cable shall be:

1. Category 6.
2. 4-pair.
3. Cable color:

    a. Data - Blue.
    b. Cameras – Yellow.

4. Sheath rated.
5. Plenum rated.
6. Approved manufacturers:

    a. Amp.
    b. Belden.
    c. Berk-Tec.
    d. Comm Scope.
    e. Mohawk.
    f. Superior Essex.
    g. General Cable.
    h. West Penn.

2.2 WIRELESS ACCESS POINT DATA CABLE

A. All data cable for WAP locations shall be:

1. Category 6A, copper. No copper-clad aluminum cabling is allowed.
2. 4-pair.
3. All cable to be Plenum rated.
4. Green cable
5. Provide service loop as indicated in detail on drawings.

2.3 DATA CABLE – WATER BLOCKED

A. Provide water blocked cable for any slab-on-grade floor box application or data cable installed in conduit in or under slab. Cable is not plenum rated and must be installed in conduit if installed above the ceiling in a plenum space. PVC conduit may be routed underground directly to data room in lieu of using EMT above ceilings. Cable shall be:

1. Category 6
2. 4-pair.
3. Color – blue (if available)
4. Approved for wet locations.
5. Flooded for moisture protection.

6. Sheath rated.

B. Where shown ceiling mounted, terminate each cable on single port surface mounted biscuit, CommScope SMB-1P-262 or equal

1. Green Jack

C. Where shown wall mounted, mount as typical data outlet

1. Green Jack

2.4 FIBER OPTIC CABLE

A. General backbone cable

1. Single-mode
2. Plenum-rated armored for interior fiber runs.
3. 12-strands
4. CommScope TerraSpeed or Equal.

2.5 DATA SYSTEM FIBER OPTIC RACK TERMINATION AND SUPPORT

A. The fiber cables between the Main data closet and remote data closet shall have all of the strands terminated at each termination point.

B. Strain relief on incoming cables.

C. Storage of a minimum of one meter of optical fiber per connector and shall provide a minimum bend radius of 1.2 inches.

D. Accommodate a minimum of twelve (6) connector and accommodate ST, SC, SMA, D4, FC, and SFF types of connector interconnecting sleeves.

E. Accept fibers having a cladding diameter of 125 microns.

F. Rack mounted support assembly for mounting of four port plates.

G. Six-port, LC duplex, multi-mode plates with designation bezel.

H. Cable support for cables into rack and patch cables.

I. Door over enclosure.

J. Manufacturers:

1. CommScope or equal.

2.6 WORK STATION COMMUNICATION OUTLETS - WALL MOUNTED

A. See floor plans for communication connector types to be included at each work station communication outlet location.

B. Each communication outlet shall consist of:

1. 4" square, 2 1/8" deep outlet box.
2. Single gang ring.
3. 1" conduit stubbed into ceiling space, either stubbed into room, or if cable tray is provided, stubbed toward cable tray. If cable tray is not provided, stub toward corridor. Provide insulated connector on each end.
4. Communication outlet plate.

C. Provide wall mount face plates, combination type. Face plate to include the following:

1. 4-position openings for keystone type jacks.
2. Label holders with label and clear plastic label cover.
3. Typed overlay label affixed above each outlet position indicating the outlet number.
4. Face plates shall be white.
5. All empty openings shall be closed.
6. Provide the appropriate communications device in the opening as shown on the floor plans.

D. Data outlets 568B configuration RJ-45 (Category 6 and 6A). Data outlets shall be power sum rated. Outlets shall meet the following minimum requirements:

1. Power sum next @ 100 Mhz = 40 dB.
2. Next @ 100 Mhz = 42 dB.
3. Attenuation @ 100 Mhz = .4 dB.
4. Return loss @ 100 Mhz = 18 dB.
5. Outlet Color:

    a. Data - Blue.
    b. Cameras – Yellow.
    c. WAP – Green (CAT6A).

E. Wall phone mounting plates:

1. Stainless steel with two mounting studs.
2. 8-position 110 IDC.

2.7 PATCH PANELS CATEGORY 6 AND 6A

A. Patch panel shall be as follows. All patch panels shall be power sum rated and tested in a link configuration. Devices shall have same rating as station outlets.

1. 48 jack, 2U 3.5" high assembly.
2. Each jack shall have an associated “type-on” label for marking and shall be marked.

3. Each patch panel shall be identified with an engraved nameplate. Plate shall be designated as: "Data Distribution Patch Panel #1". The next patch panel shall be identified as "Patch Panel #2". etc. For projects where there are more than 1 network rack, each rack shall be further identified with a label indicating that it is Data Network Rack #1, #2, etc.
4. Each patch panel rack/enclosure shall have vertical wire management on both sides.

2.8 FIBER OPTIC CONNECTORS

A. The Optical Connector shall be SC type (bayonet mount).

B. The connector ferrule shall be ceramic or glass-in-ceramic. The optical fiber within the connector ferrule shall be secured with an adhesive.

C. The attenuation per mated pair shall not exceed 0.7-dB (individual) and 0.5-dB (average). Connectors shall sustain a minimum of 200 mating cycles per EIA/TIA-455-21 without violating specifications.

D. The connector shall meet the following performance criteria:

Test Procedure	Max. Attenuation Change
Cable Retention (FOTP-6)	0.2-dB
Durability (FOTP-21)	0.2-dB
Impact (FOTP-2)	0.2-dB
Thermal Shock (FOTP-3)	0.2-dB
Humidity (FOTP-5)	0.2-dB

2.9 DATA PATCH CABLE

A. Provided by owner.

2.10 DATA RACKS AND ACCESSORIES

A. Open 2-Post Mounting Rack - Floor Mounted

1. 84" high.
2. 19" standard width.
3. For each 48 unit or less patch panel assembly, provide one front mounted wire manager panel for routing of hub cables and one rear mounted wire manager panel for controlling cables entering back of patch panel.
4. Provide appropriate vertical wire manager loops to provide a training and attachment point for vertically run cables. Assume that a minimum of four will be required per enclosure. Actual location to be determined in field based on where cables enter and exit cabinets.
5. Constructed of aluminum color black.
6. Both sides drilled.
7. Hole mounting pattern: 5/8", 5/8", 5/8".
8. Rack shall be bolted to floor.

9. Rack shall be bonded to grounding system. Provide bonding jumper from rack to nearest available grounding source with ground point provided in room. Bond to ground point.
10. Provide a minimum of one solid equipment tray double ended, 18 3/4" deep.
11. Provide strut frame to support cables to above ceiling.
12. Provide horizontal rack mounted power strip including 8 outlets (4 in back and 4 in front). Provide an internal TVSS unit. Plug strips shall be connected to a cord. Hubbell MCCPSS19TS or equal.
13. Provide vertical wire management panels. Provide wire management panelsvertically along both sides.
14. Manufacturer:

    a. Ortronics OR-19-84-6T2SD-CMB.
    b. Panduit CMR19X84.
    c. Hubbell HPW84RR19.
    d. Lucent equal.
    e. B-line equal.
    f. Hoffman equal.
    g. PFT equal.
    h. CPI equal.

B. Free-standing enclosure 4 post type:

1. CPI 19x84 15215-703 black or equal
2. Plug strip:
3. Trip Lite DRS -1215 rack mounted. Or equal
4. Vertical mounted management:

2.11 LADDER RACK

A. CPI 12” black or equal

2.12 TELEVISION OUTLET - TYPE F - GREEN COLOR.

A. Each outlet shall be an AT&T networking system modular information outlet. Equipment shall be as follows:

B. M81C coaxial video coupler module.

C. M106FR2 modular mounting frame.

D. M20A dust cover/blank.

2.13 TELEVISION SPLITTERS/COMBINERS:

A. Provide splitters and combiners as required.

2.14 KEYLESS ENTRY CABLING

A. Provide Keyless Entry cabling to each door where directed by Keyless Entry supplier. Keyless entry devices and installation of devices by others. Coordinate exact cabling requirements at each door with keyless entry supplier prior to bid.

B. 18-gauge shielded, two-pair with ground.

1. Provide plenum version of this cable where routed overhead.
2. Provide water blocked version of this cable where routed underground.

C. 22-gauge shielded, 6 conductor with ground.

1. Provide plenum version of this cable where routed overhead.
2. Provide water blocked version of this cable where routed underground.
3. Cable to be Manhattan or equal

2.15 WALL MOUNTED AMPLIFIER

A. Provide where required at closets.

B. Blonder Tongue BIDA 100A-30 with integrated active return.

C. Provide internal equalizers as required.

D. Gain control range 15 dB.

E. Slope control range 10dB.

F. Gain 31 dB.

2.16 J-HOOKS

A. Data cable supports

1. Caddy Cat HP J-Hook.

2.17 PLYWOOD BACKBOARD

A. Provide 4 x 8 fire resistant painted plywood, AC grade, good one side, where shown on walls. Paint plywood white with fireproof paint. Provide cutout for flush receptacles. Furnish and install extension rings.

2.18 DATA EQUIPMENT LABELS

A. See specification section 26 05 53 for label materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify surfaces and areas are ready to receive work.

B. Verify field measurements are accurate and shown on drawings.

C. Verify proper power connections are installed.

D. Proceed with installation only after unsatisfactory conditions are corrected.

E. All wiring shall test free from grounds and shorts.

3.2 FIELD MEASUREMENTS

A. Field verify exact location for all wall racks.

3.3 DELIVERY, STORAGE & HANDLING

A. Receive, sign for, and store all equipment in this section.

B. Maintain original quality and condition of equipment while it is in storage.

3.4 INSTALLATION

A. All voice, and data jacks to be labeled at device location and origination within 6” of end of cable.

B. Provide complete testing and documentation as listed in 1.6 Operation & Maintenance Manuals.

C. General

1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer’s recommendations.
2. Install all materials, assemblies and equipment in strict accordance with manufacturer’s recommendations and instructions. Consult manufacturer for all wiring diagrams, schematics, sizes, outlets, etc. before installing.
3. Start of installation shall not begin until areas are broom clean, properly lighted, exterior enclosing walls in place, exterior windows glazed, roof completely installed to prevent weather damage to equipment, and written notice received from Architect stating that these conditions exist at building site.

D. Cleaning

1. Prior to turning the system over to the Owner, the system shall be physically cleaned.
2. All appearance defects shall be carefully and professionally touched up so that the equipment is in “factory new” condition.
3. At the completion of the work, remove from the building and the premises all rubbish and debris resulting from the work.

E. Raceways

1. There shall be no sharp edges with installed materials.

F. Cable

1. All wire runs shall be continuous lengths, without splices.
2. All wiring systems shall be color coded as shown on the drawings. Green conductors shall be used only for grounding conductors, white only for neutral conductors, and black shall be reserved for 120-volt line.
3. Marker strips shall be attached to the field wiring. These markers shall not change when devices are replaced during repair or maintenance.
4. Within equipment cabinets, all wires and cables shall be contained in wire management channels such as Panduit or equal, and dressed and labeled in such a manner that all wires may be easily traced, and such that they do not obstruct access to components which may need to be replaced or serviced.
5. All low voltage cabling to be routed in “D” rings or in cable tray.

G. Grounding

1. All equipment shall be grounded in accordance with NEC, these specifications and drawings, and the equipment supplier’s recommendations.

    a. All equipment installed in a cabinet shall be bonded to the cabinet frame.

H. Final Testing

1. The completed data system shall be fully tested by the Contractor. Upon completion of a successful test, certify in writing to the Owner.

I. Conduit stubs: The plan notes indicate, in a number of locations, the appropriate termination point for conduit stubs. In areas where ceilings are unfinished or ceilings are inaccessible by either height or for other reasons, the conduit stubs shall be extended to a further location to an accessible area. Lay out conduit runs such that all data installation runs are 300' or less.

J. Numbering and labeling:

1. All communication outlets shall be provided with an overlay label indicating the outlet number. This shall be provided for all devices mounted in the communications faceplate.

K. Data and Voice cables - UTP

1. Shall be installed in raceways and cable trays where applicable.

2. Where cable is run in the open, it shall meet the following criteria:

    a. Routed through "J-hook" system.
    b. Maintain at least a 12" separation from fluorescent or neon lighting fixtures.
    c. Maintain at least a 3.3' separation from transformers, motor or other sources of electromagnetic fields.
    d. Maintain the following separation from unshielded power cables - 36".
    e. Maintain separation from under cabinet fluorescent fixtures installed on modular furniture.
    f. Do not route within 50' of arc welders.

L. Cable Termination

1. All cable conductors shall be terminated per EIA/TIA cable terminating standards as recommended by the manufacturer of the data system.

M. Cable Support & Raceways

1. In areas where cable trays are provided, cables shall be installed within the trays. Extend cables from trays to conduit stubs down to outlets.
2. In areas where there are not accessible ceilings, cables shall be installed in surface mounted, non-metallic or metallic raceway as specified in specification section 26 05 34. Provide all ceiling raceways where multiple cables are run with a minimum of 50% additional space to allow for future cables to be added. If surface raceway size is shown on drawings, provide that size or larger or multiples of the size shown as required.
3. Above accessible ceilings, a "J-hook" support system shall be used throughout the ceiling space, tunnel space, mezzanines, and other areas where cables are run. The "J" shall have flat bottom to eliminate single point stress on cables supported. Cables shall not be installed in a hap-hazard manner across the ceiling grid system. The following method shall be used:

    a. Conduits that are stubbed into the accessible ceiling space that are acting as cable raceways shall be extended into the nearest corridor space, or, as an option, install a sleeve through any wall separating the room from the corridor area.
    b. Cables shall be routed at 90 degrees from the room to the J-hook support system in the corridor. The corridor area shall generally be defined as the area where the J-hook support system shall be installed. However, in the event that there is not adequate corridor space, the J-hook system may be moved into the adjacent rooms.
    c. J-hook system shall be installed in straight lines perpendicular, right angle to the building walls. Groups of J-hooks shall be used where the single J-hook system is not adequate to support the cabling.
    d. The support system shall be used up to the conduits that feed the cables into the outlet or cable distribution points. Mark the record drawings to indicate the approximate path of the support system.
    e. Mark the "record drawings" to indicate the approximate path of the J-hook system.

4. Maximum spacing between J-hooks is to be 3'.

N. Provide and install all wall sleeves and penetrations. Any place that a wall is penetrated to route cable through the wall, the contractor shall provide a through-the-wall sleeve. This may be PVC conduit in those areas where plenum cable is not used. It shall be steel conduit with

insulated connectors on ends in those areas where plenum ceilings are used. Assume that for each door entering each room, to include in pricing, the cost of providing and installing one sleeve above all doors entering rooms. These sleeves shall be installed above the ceiling grid.

O. In those areas where there is not an existing ceiling, all system cables shall be routed through conduit, through the non-ceiling area, into an area where there is ceiling cavity. There shall be no open cables routed through ceiling areas unless it is indicated otherwise on the drawings.

P. Cable Labeling Scheme

1. The Owner has implemented an existing data cabling and patchpanel outlet labeling scheme which the contractor will be required to follow for this project.
2. The scheme labels the cable and outlet numbers based on the telecommunications closet location, patchpanel location within that rack, and the outlet number on that patchpanel. The contractor will be required to meet with the owner's telecommunications facility coordinator prior to providing data cabling. For this project the contractor will be required to determine that prior to equipment and cable listing submittal, and from that information, provide the appropriate label numbers on the submittal documents. This submittal will be required prior to installation.

Q. Patch Panel Installation

1. Patch panels shall be installed and connected such that the incoming cables are grouped by rooms, spaces, and departments. It will be the contractor or his supplier's responsibility to initially meet with the Owner to determine what the requested groupings are.
2. The submittal drawings for the data system shall include front elevations of all patch panels should be shown with a number that will be associated with each patch panel jack. See system documentation for additional requirements. There shall be a listing indicating which jack is connected to which outlet, i.e. room space or department.
3. Incoming cables to patch panels shall be neatly trained and attached via cross-frame members or other method to hold cables independent of patch panel jacks.

R. Data Rack/Cabinet Installation

1. Racks and enclosures shall be bolted to the floor.
2. Racks shall be bonded to grounding system.
3. Racks shall be bonded to each other using a flexible bonding strap bolted to enclosure/rack.

END OF SECTION 271000

SECTION 275150 - PAGING SYSTEM

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.2 APPLICABLE PUBLICATIONS

A. Conform to requirements of current ANSI/NFPA 70 – National Electric Code.

B. Conform to current Underwriters Laboratories (UL) Specifications and Standards.

C. Conform to current Telecommunication Industry Association (TIA/EIA).

D. Compliant with limits for Federal Communication Commission (FCC) Class B device.

E. Conform to current National Electrical Manufacturers Associates (NEMA) Standards.

F. UL Listing - All material and equipment shall be listed, labeled, or certified by Underwriters Laboratories, Inc. The intercom/paging system shall be UL 813 listed as a complete system. All power supplies and computers shall be UL listed. Provide UL listing cards for all components specified herein.

1.3 DESCRIPTION OF WORK

A. The paging system will consist of all speakers, wiring, rack mounted Biamp DSP, amplifiers and page adaptor located in the IT Room shown on the plan. The DSP will be connected to a Valcom paging interface device. Provide a rack mounted shelf to mount the Valcom paging interface device in data rack. This system to allow for a data input from the owners network system to allow for speaker annunciation by zone or all page thru owner furnished software or IP phone system. Furnish and install a complete and operable intercommunications system as indicated on the drawings and as specified herein.

B. Paging Zones to consist of: Zone 1 – Inside Speakers, Zone 2 – Outside Speakers and All Call

C. System Inputs to Consist of: Input 1 – Phone System Paging

D. Paging System vendor shall include in bid time to coordinate all work with owner to interface the paging system to the owner’s phone system and all work to interface the radio system to the paging system.

E. All necessary equipment required to meet the intent of these specifications, whether or not listed within these specifications, shall be supplied and installed to provide a complete and operational system.

1.4 RELATED WORK ELSEWHERE

A. Division 26 – Electrical.

1.5 SHOP DRAWINGS

A. Submit shop drawings in accordance with Division 01.

B. The following information shall be submitted in addition to items listed above:

1. Wiring diagram indicating wire size and type for each individual piece of equipment.
2. Complete riser diagram indicating all equipment and interconnecting components with indication of location of each device.
3. All drawings must be in CADD format.
4. Block diagram indicating major system components and their relationship with other components.
5. A complete riser diagram indicating all head-end and other components with wire type and wiring diagrams.

C. Submit cut sheets as outlined in Division 01 and include system riser diagram, all wire, devices, and provide written confirmation from the factory that they are an authorized representative for the submitted product. This document shall be included as part of the submittal data.

D. Provide complete brochure information on all components and accessory equipment. All information shall be clearly marked to indicate items provided.

1.6 OPERATION & MAINTENANCE MANUALS

A. Submit Operations & Maintenance Manuals in accordance with Division 01.

B. The following information shall be submitted in addition to the items listed above:

1. Wiring diagram indicating wire size and type for each individual piece of equipment.
2. Complete riser diagram indicating all equipment and interconnecting components with indication of location of each device.
3. Provide copy of written warranty.

1.7 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Division 01.

B. The following shall be provided in addition to items listed above.

1. Arrange pre-installation meeting.
2. Factory Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer’s products that are similar in material, design, and extent to those indicated for this Project.

3. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
4. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation. Report results in writing.
5. Manufacturer must carry replacement parts.

1.8 WARRANTY

A. The supporting devices shall be warranted for a period of not less than 1 year from the date of commissioning against defects in materials and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, and repair parts cost.

C. Submit a written warranty executed by the installer agreeing to repair or replace any paging equipment that fails within the warranty period.

D. During the guarantee period there shall be no charges to the Owner for service calls for guarantee work. However, when service work is required to repair items damaged by neglect, misuse, or vandalism, costs shall be reimbursed to this Contractor.

E. 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.

F. Guarantee his work and equipment for a period of one year from date of acceptance of project by the Owner. Neither the final payment, nor any provisions in contract documents shall relieve this Contractor of the responsibility for faulty materials and/or workmanship for a period of one year. Remedy any defects due thereto, and pay for any damage to other work resulting therefrom.

G. Employ factory trained technical service personnel for service and maintenance of the system should service be required.

H. Carefully instruct the Owner's technical personnel in the operation, care and maintenance of the system.

I. It shall be possible for the Owner's technical personnel to attend Service and Maintenance Seminars conducted by the systems manufacturer to educate them in the technical aspects of the system.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials and equipment shall be new (less than 1 year old when turned over to the Owner).

B. Provide a complete and fully functional paging system using materials and equipment of types, sizes, and rating as required to meet performance requirements. Use materials and equipment that comply with referenced standards and manufacturer's standard design and construction, in accordance with published product information. Coordinate the features of all materials and equipment so they form an integrated system, with components and interconnections matched for optimum performance of specified functions. Provide all accessories necessary for a fully functioning system.

C. Definitions

1. Where the word "Provide" is used, it shall be defined as requiring the furnishing and installing of the item or facility indicated, complete in all respects and ready for operation unless otherwise specifically noted.

D. Intercom Features

1. Interface with owners network system
2. Provide UPS to allow system to operate during loss of power. Power outage to be min of one minute.

E. Scope of Work

1. Furnishing of all labor, superintendence, materials, tools, equipment and sources necessary for the complete installation.
2. Furnish and install a system complete in every respect and ready to operate. All miscellaneous items and accessories required for such installation whether or not each such item or accessory is shown on the plans or mentioned in these specifications shall be furnished and installed. The architectural, structural, mechanical and electrical drawings and specifications are included in this division in that they establish requirements and limitations of work to be performed under this section.
3. It shall be the responsibility of each bidder to examine the plans and specifications carefully before submitting his bid, with particular attention to errors, omissions and conflicts between plans and specifications. Any such discrepancy discovered shall be brought to the attention of the Engineer and will be included in the Base Bid.

F. Qualified Contractor

1. All systems herein specified shall be provided by a single source, installed equipment by an Authorized Factory Distributor for the equipment (not an Electrical Contractor), shall

stock spare parts and maintain a staff of trained, certified technicians. A minimum of five years experience in the application of equipment is required.

2.2 MIXER / DSP

A. Manufacturer

1. Biamp Nexia CS 10 x 6 Digital Signal Processor
2. Biamp Volume 8, Rack mount in Lowell SG6P-3

B. POWER AMPLIFIER (size as required plus 20% headroom):

1. Provide Amplifier quantity 2 QSC ISA300TI or equal

2.3 AUDIO PAGING EQUIPMENT

A. Paging Interface

1. Provide Valcom VIP-204A with rack mount kit

2.4 VOLUME CONTROLS

1. Provide Lowell 25LVC-S* volume control, confirm color with Wiring Devices specified in section 26 27 26.

2.5 INTERCOM COMMUNICATIONS SYSTEM

A. Intercom Field Hardware

1. Loudspeakers shall be eight inch seamless cone type. The ceramic magnet shall weigh at least 4.8 ounces. The frequency range shall be from 90 to 15,000 Hz. The normal wattage rating shall be 8 watts with a program rating of 12 watts. The voice coil diameter shall be 3/4" and the impedance 8 ohms. The loudspeaker shall be equipped with a universal matching transformer suitable for use on a 25-volt output line with taps at 1/2, 1, 2 or 4 watts.
2. Atlas SD72WV. Atlas SD72 for areas without ceilings:

    a. Speakers (flush mounted) shall be mounted in a Soundolier EZ95-8 or equal back box where shown to be mounted individually on the plans.
    b. Speakers mounted in ceiling spaces where there are not ceilings shall be provided with an Atlas L20-213 or equal surface mounted speaker enclosure with Atlas 161-8 or equal baffle to match above. Provide mounting hardware, Kindorf or similar, to suspend speaker to deck.

3. Building wall mounted horn speakers shall be Atlas APF-15T or equal
4. Building exterior speakers shall be Atlas APF-15T -speaker/VP161A-APF- baffle/193-8 6" deep back box, grille shall be painted to match building exterior finish for flush mounted applications. Provide surface WP back boxes and WP baffles for speakers

shown on existing walls. Paint exterior speakers custom color per Architect to match building surfaces. Include painting cost in bid.

2.6 WIRE AND CABLE

A. The speaker cable shall be a UL listed 18 AWG stranded copper conductor with plenum rated insulation. Each cable shall have 2 twisted conductors shielded with an aluminum mylar tape shielded material and have a 22 AWG tinned drain wire. Each cable shall also have 1 conductor not shielded.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify surfaces and areas are ready to receive work.

B. Verify field measurements are accurate and shown on drawings.

C. Verify proper power connections are installed.

D. Proceed with installation only after unsatisfactory conditions are corrected.

E. All wiring shall test free from grounds and shorts.

3.2 FIELD MEASUREMENTS

A. Field verify surfaces where intercom equipment will be located. Verify adequate room for recessed equipment. Adjust locations to satisfy field measurements.

B. Mounting heights as shown on drawings and details. Coordinate final locations with on-site architect prior to rough-in.

3.3 DELIVERY, STORAGE & HANDLING

A. Receive, sign for, and store all equipment in this section.

B. Maintain original quality and condition of equipment while it is in storage.

3.4 INSTALLATION

A. General

1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer’s recommendations.

2. Install all fixtures, materials, assemblies and equipment in strict accordance with manufacturer's recommendations and instructions. Consult manufacturer for all wiring diagrams, schematics, sizes, outlets, etc. before installing.
3. Mount all equipment except portable equipment firmly in place. Clearly, logically and permanently mark all switches, jacks and receptacles.

B. Cable Installation

1. Install all equipment per manufacturer's instructions and directions.
2. In areas where cable trays are not used for cable installation, a "J-hook" support system shall be used throughout. Maximum spacing between support hooks shall be 3' on center. Cables shall not be installed in a hap-hazard manner across the ceiling grid system. The following method shall be used:

    a. Conduits acting as cable raceways that are stubbed into the accessible ceiling space shall be extended into the nearest corridor space, or, as an option, the contractor shall install a sleeve through any wall separating the room from the corridor area. Cables shall be routed at 90 degrees from the room to the support system in the corridor. In the event that there is not adequate corridor space, the support system may be moved into the adjacent rooms. Make modifications, as necessary, in the support system to minimize cable lengths.
    b. J-hook system shall be installed in straight lines perpendicular, right angle to the building walls. Groups of J-hooks shall be used where the single bridal ring system is not adequate to support the cabling.
    c. The support system shall be used up to the conduits that feed the cables into the outlet or cable distribution points. Mark the record drawings to indicate the approximate path of the support system.
    d. Mark the "record drawings" to indicate the approximate path of the J-hook system.

3. Provide and install all wall sleeves and penetrations. Any place that a wall is penetrated to route cable through the wall, provide a through-the-wall sleeve. This may be PVC conduit in those areas where plenum cable is not used. It shall be steel conduit with insulated connectors on ends in those areas where plenum ceilings are used. For each door entering each room, include in pricing, the cost of providing and installing one sleeve above all doors entering rooms. These sleeves shall be installed above the ceiling grid.
4. In those areas where there is not an accessible ceiling, all system cables shall be routed through conduit, through the non-ceiling area, into an area where there is ceiling cavity. There shall be no open cables routed through ceiling areas, unless it is indicated otherwise on the drawings.

C. Wiring

1. Provide conduit systems to accessible spaces only and mount all boxes for the systems wiring. Special boxes (i.e. speaker boxes, amplifier boxes, etc.) as shown on the project drawings shall be provided by the systems contractor for installation by the Electrical Contractor.
2. It shall be the responsibility of the systems contractor to furnish and install all wire and cable for the system.

D. Cleaning

1. Prior to turning the system over to the Owner, the system shall be physically cleaned.
2. All appearance defects shall be carefully and professionally touched up so that the equipment is in "factory new" condition.
3. At the completion of the work, remove from the building and the premises all rubbish and debris resulting from the work.

E. Raceways

1. All screws used for anchoring conduit and J-boxes parts in public or resident areas shall have tamperproof screws.
2. All screws used on signal devices, including speakers, shall be of the tamperproof type.
3. There shall be no sharp edges with installed materials.

F. Cable

1. Vendor to verify exact cable required based on the equipment and provide appropriate cable.
2. All cables to be plenum rated.
3. All wire runs shall be continuous lengths, without splices.
4. All wiring systems shall be color coded as shown on the drawings. Green conductors shall be used only for grounding conductors, white only for neutral conductors and black shall be reserved for 120-volt line.
5. All control wiring systems shall use stranded copper conductors terminated with crimp connectors or lugs, correctly sized for the termination, and applied to the conductor with a crimping tool intended for use with the lug used, or to terminal strips providing 360 degree capture of the wire.
6. Marker strips shall be attached to the field wiring. These markers shall not change when devices are replaced during repair or maintenance.
7. Within equipment cabinets, all wires and cables shall be contained in wire management channels such as Panduit or equal, and dressed and labeled in such a manner that all wires may be easily traced, and such that they do not obstruct access to components which may need to be replaced or serviced.
8. All low voltage cabling to be routed in "D" rings or in cable tray.

G. Grounding

1. All equipment shall be grounded in accordance with NEC, these specifications and drawings, and the equipment supplier's recommendations.

   a. Each cabinet frame shall be grounded. Equipment cabinets shall be bonded directly to the building electrode grounding.
   b. All exterior panels of cabinets shall be bonded to the cabinet frame.
   c. All equipment installed in a cabinet shall be bonded to the cabinet frame.

H. On Site Programming

1. The system supplier shall provide on-site programming. He shall program the unit in conjunction with the owner's requirements. The systems supplier shall plan on spending a minimum of one day on site with the owner to provide all programming for the system.

I. Final Testing

1. The completed intercom system shall be fully tested in accordance with NFPA by the Contractor in the presence of the Owner's representative and the Engineer. Upon completion of a successful test, the Contractor shall so certify in writing to the Owner.
2. All wiring shall test free from all grounds and shorts.
3. Upon completion of the installation, the system must be tested by the manufacturer's representative and all necessary modifications and/or adjustments must be made to assure compliance with this specification.
4. Upon completion of the testing, the manufacturer or his representative shall issue to the Owner a letter of certification attesting to the fact that he has tested and adjusted the system, that all components are properly installed and free of defects, and that the system is in compliance with this specification.

3.5 OWNER TRAINING

A. Provide complete operator training for the Owner's personnel.

B. Use submitted Operations & Maintenance manuals as reference during this demonstration and tour.

C. The work shall include supplying the services of a field service representative who shall be a full-time employee. The field service representative shall have specialized experience in the operation and maintenance of the system and shall instruct the Owner's personnel in the techniques involved in the operation of the systems. A formal on-site training shall be provided by this contractor to the owners representative/maintenance personnel and shall include instructions in the location, inspection, maintenance, testing and operation of all electronic components. Provide a minimum of two hours of general instruction. Provide a signed copy of the name of the personnel giving the instructions and the personnel of the Owner.

D. Diagrams, Drawings and Instruction Manuals

1. Furnish bound instruction manuals for the complete system for the Owner's use.

2. Manuals shall include instructions, block and schematic diagrams, wiring diagrams, specification and technical data of the components, and "as-built" drawings of the completed system.

3.6 SPARE EQUIPMENT (NONE)

END OF SECTION 275150

SECTION 283100 - ADDRESSABLE FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 APPLICABLE PROVISIONS

A. Drawings and general provisions of contract, including general and supplemental conditions and Division 01 specification sections, apply to work of this section.

1.2 APPLICABLE PUBLICATIONS

A. NFPA 70 - National Electrical Code (NEC) generally, and Article 760 in particular

B. NFPA-72 – National Fire Alarm Code

C. NFPA 101 - Life Safety Code

D. NFPA-90A - Installation of Air Conditioning and Ventilating Systems

E. Local and State Codes

F. National Electrical Manufacturer's Association (NEMA)

G. Underwriters' Laboratories, Inc. (UL)

1. UL-864 Control Units for Fire Protective Signaling Systems
2. UL-268 Smoke Detector for Fire Protective Signaling Systems
3. UL-217 Smoke Detectors for Single and Multiple Station
4. UL-521 Heat Detectors for Fire Protective Signaling Systems
5. UL-464 Audible Signaling Appliances
6. UL-1971 Visual Signaling Appliances
7. UL-38 Manually Actuated Signaling Boxes
8. UL-1481 Power Supplies for Fire Protective Signaling Systems

1.3 DESCRIPTION OF WORK

A. The work covered by this section of the specifications includes the furnishing of all labor, equipment, materials, and performance of all operations associated with the installation of the new Fire Alarm System as shown on the drawings and as herein specified.

B. Furnish and install a complete Multiplex/Intelligent Fire Alarm System as described herein and as shown on the plans; to be wired, connected, and left in first class operating condition.

C. The new fire alarm system shall be an intelligent/analog type, and shall consist of a single Main Fire Alarm Control Panel (FACP), and Fire Alarm Annunciator Panel(s) (FAAP), unless a different design is submitted and approved.

D. The new fire alarm system shall be configured as a remote station signaling system, as defined in NFPA-72, and shall use/incorporate the following features, as a minimum:

1. The latest intelligent analog, addressable technology (detectors/sensors and modular panel equipment) currently available from the manufacturer.
2. Coded, Horn-type Audible Notification Appliances.
3. Signaling Line Circuits (SLCs), connecting addressable field points to the associated Fire Alarm Control Panel, shall be configured as NFPA style 4 (Class B), with point supervision.

    a. Isolated SLC Circuits, or circuit branches shall be provided, so that separate areas or floors are independently isolated (a single Short Circuit or Ground Fault, on the SLC wiring on any floor shall not affect the proper operation of the SLC serving any other floor).
    b. Floors with more than 25 Addressable Devices shall be split into isolated SLC sub-circuits where each circuit shall not have more 25 devices. Where this is done, the floor shall be "split" along a logical, physical boundary.

4. Network Connections, Data, Audio, and Signaling Line Circuits, which functionally link together multiple panels or transponders shall be wired in an NFPA Style 6 (Class A) arrangement.
5. Initiating Device Circuits (IDCs) shall be limited to short runs from Monitor Modules to the connected device, unless specifically stated otherwise herein, and shall be configured as NFPA Style B (Class B), with individual zone supervision.
6. Notification Appliance Circuits (NACs) shall be configured as NFPA Style Y (Class "B"). Provide 25% spare capacity for future devices.
7. Data Circuits to Annunciators shall be configured as NFPA Style 4 (Class "B"). All annunciators shall be fully supervised.

E. Provide UL 864 listed IP/cellular digital communicator for remote monitoring. Provide one year monitoring service for fire alarm system. Contract period shall start at date of substantial completion. Coordinate dialing sequence with Owner.

F. The fire alarm system shall allow for loading and editing special instructions and operating sequences as required. The systems shall be capable of on-site programming to accommodate system expansion and facilitate changes in operation. All software operations shall be stored in a non-volatile programmable memory within the fire alarm control panel. Loss of primary and secondary power shall not erase the instructions stored in memory.

G. Within this specification, unless specifically noted otherwise, the term "detector" shall be used to refer to automatic fire detectors, which support either Analog Addressable or Intelligent Addressable detection technologies, as follows:

1. "Analog Addressable Sensor" technology – where the Sensors utilized within this system function as non-intelligent or semi-intelligent transducers, which report Analog Values to the FACP. Where this technology is employed, historical data and / or floating average values associated with each Sensor – such as the Average, Peak, and Current Obscuration Values, shall be maintained within the memory of the FACP. Where Analog Addressable Sensors are utilized, Alarm conditions shall be determined by the FACP based upon readings reported by the various Sensors.

2. "Intelligent Addressable Smoke Detector" technology – where the detectors utilized within this system function as intelligent detectors. These detectors shall contain processing and memory circuits within each detector unit. If desired, the Analog Smoke Obscuration Value at any such detector can be manually retrieved to the FACP for report or adjustment purposes. Where Intelligent Addressable Detectors are utilized, historical data and / or floating average values associated with each Sensor – such as the Average, Peak, and Current Obscuration Values, shall be maintained within the memory of detector itself. Where Intelligent Addressable Smoke Detectors are utilized, Alarm conditions shall be determined locally, at the detectors.

H. For purposes of this specification, analog addressable sensors and intelligent addressable detectors, as described above, shall be considered to be functionally equivalent.

1. In either case, non-addressable detectors shall be unacceptable, except at individual locations where specified – where ambient environmental values prevent use of addressable units.
2. Simple Addressable systems, which do not support Analog Addressable or Intelligent Addressable detection technology shall also be unacceptable.

1.4 RELATED WORK ELSEWHERE

A. Division 23 – Heating, Ventilation and Air Conditioning

B. Division 26, 27, and 28 – Electrical.

1.5 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 26 05 04.

B. The following information shall be submitted in addition to items listed above:

1. Wiring diagram indicating wire size and type for each individual piece of equipment.
2. Complete riser diagram indicating all equipment and interconnecting components with indication of location of each device.
3. All drawings must be in CADD format.
4. Block diagram indicating major system components and their relationship with other components.
5. A complete riser diagram indicating all head-end and other components with wire type and wiring diagrams.

C. Submittal drawings:

1. Provide submittal drawings that are in compliance with State requirements for fire alarm system submittals. This shall include:

a. Battery calculations
b. Voltage drop calculations for all signal lines
c. Sequence of operation
d. Wiring diagrams

e. Floor plan layout of all fire alarm devices indicating candela levels on each individual signal.

2. These shall be used, per State requirements for fire alarm submittals. This information shall be included with each set of fire alarm shop drawings.
3. Provide each submittal booklet with a table of contents that includes all items in submittal, specifically it shall include the following. This page shall be a separate page to allow engineer's stamp for State submittal.

a. Page listing for battery calculations.
b. Page listing for voltage drop calculations for all signal lines.
c. Page listing Sequence of Operation.
d. Page listing catalog cut sheets.
e. Page listing all other items that are included in the booklet.
f. Full set of fire alarm drawings with fire alarm devices indicated and proper candela levels indicated on those devices. The electrical engineer will forward bid-set CAD drawings to contractor or supplier.

D. Riser diagram with wire sizes indicated shall be shown on floor plan drawings per State of WI requirements.

E. Provide (1) one additional set of drawings and booklet along with (3) three additional drawings cover sheets for State fire alarm review.

F. Provide documentation of 1 year contract for monitoring service. Also include cost of renewal in documentation.

G. This vendor is responsible to submit all fire alarm drawings to the State of Wisconsin and Local AHJ if required; including payment of any and all submittal fees.

1.6 OPERATION & MAINTENANCE MANUALS

A. Submit Operations & Maintenance Manuals in accordance with Section 26 05 04.

B. The following information shall be submitted in addition to the items listed above:

1. Wiring diagram indicating wire size and type for each individual piece of equipment.
2. Complete riser diagram indicating all equipment and interconnecting components with indication of location of each device.
3. Provide copy of written warranty and copy of contract for 1 year monitoring service.

1.7 QUALITY ASSURANCE

A. Provide quality assurance in accordance with Section 26 05 04.

B. The following shall be provided in addition to items listed above.

1. Arrange pre-installation meeting.
2. Factory Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of

manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

3. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
4. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation. Report results in writing.
5. Manufacturer must carry replacement parts.

1.8 WARRANTY

A. The supporting devices shall be warranted for a period of not less than 1 year from the date of commissioning against defects in materials and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, and repair parts cost.

C. Submit a written warranty executed by the installer agreeing to repair or replace any fire alarm equipment that fails within the warranty period.

D. During the warranty period, provide the Owner with one update/revision of schedule definitions, i.e.:

1. Revise schedule of openings assigned to groups.
2. Revise functions allowed at openings as long as no hardware or wiring changes are required.
3. Provide one revision of the computer graphic displays (floor plans).

E. 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.

F. System Service Support:

1. The system's vendor must employ factory trained technicians and maintain a service organization within 100 miles of the job site. This organization must have a minimum of 10 years experience servicing fire alarm systems and provide 24 hour emergency service.

PART 2 - PRODUCTS

2.1 GENERAL

A. The contractor shall provide a fire alarm system manufactured by:

1. JCI/Simplex
2. Notifier
3. EST

B. All materials and equipment furnished shall be current production of manufacturers regularly engaged in the manufacture of such items, and for which replacement parts are available. All materials and equipment shall be UL 864 9th Edition Listed.

C. Provide a complete and fully functional fire alarm system using materials and equipment of types, sizes, and rating as required meeting performance requirements. Use materials and equipment that comply with referenced standards and manufacturer's standard design and construction, in accordance with published product information. Coordinate the features of all materials and equipment so they form an integrated system, with components and interconnections matched for optimum performance of specified functions. Provide all accessories necessary for a fully functioning system.

D. Power Requirements

1. The control panel shall receive 120 VAC power via a dedicated circuit.
2. All circuits requiring system operating power shall be 24 VDC and shall be individually fused at the control panel.
3. Provide supervised remote battery backed-up power supplies if required. Coordinate with contractor at bid to include 120 volt connection in bid.
4. Each fire alarm control panel and remote power supply shall be connected to separate dedicated branch circuit, maximum 20 amperes. Circuit shall be labeled as "FIRE ALARM". The breaker shall be painted red and cap-locked. The location of the circuit shall be permanently identified at the control panel.
5. Size batteries per NFPA 72 for secondary power supply requirements.

E. Alarm Sequence

1. The system alarm operation subsequent to the alarm activation of any manual station, automatic detection device, or sprinkler flow switch is to be as follows:

    a. All audible alarm indicating appliances shall sound until silenced by the alarm silence switch at the control panel.
    b. Xenon strobes shall display a continuous pattern until system is reset.
    c. All doors normally held open by door control devices shall release.
    d. To accommodate and facilitate job site changes, the type of "city connection circuit" is to be on site configurable to provide a "reverse polarity", "local energy", "shunt" or dry contact connection.
    e. The mechanical controls shall activate the air handling systems per life safety specification NFPA 101.
    f. Upon reset of control panel, air handling units shall sequentially start up to reduce electrical demand.

2. The alarm activation of any elevator lobby smoke detector shall, in addition to the operations listed above, cause the elevator cabs to be recalled according to the following sequence:

    a. If the alarm detector is on any floor other than the main level of egress, the elevator cabs shall be recalled to the main level of egress.

b. If the alarmed detector is on the main egress level, the elevator cabs shall be recalled to the predetermined alternate recall level as determined by the local authority having jurisdiction.

3. The activation of any system smoke detector shall initiate an Alarm Verification operation whereby the panel will reset the activated detector and wait for a second alarm activation. If, within one minute after resetting, a second alarm is reported from the same or any other smoke detector, the system shall process the alarm as described previously. If no second alarm occurs within one minute, the system is to resume normal operation. The Alarm Verification is to operate only on smoke detector alarms. Other activated initiating devices shall be processed immediately. The alarm verification operation is to be U.L. listed.
4. The control panel is to have a dedicated system trouble LED and a dedicated trouble acknowledge switch.

a. Alarm Silencing:

1) Should the "Alarm Silence" button be pressed, all alarm signals shall cease operation.
2) Signals shall not be silenced during alarm silence inhibit mode.

b. System Reset:

1) The "System Reset" button shall be used to return to its normal state after an alarm condition has been remedied.
2) Should an alarm condition continue to exist, the system will remain in an abnormal state. System control relays shall not reset. The panel Priority Alarm LED shall remain on. These points will not require acknowledgement if they were previously acknowledged.

5. A manual evacuation switch shall be provided to operate the systems alarm notification appliances. Other control circuits shall not be activated. However, a fire alarm shall be processed as described previously.
6. Activation of an auxiliary bypass switch shall override the automatic functions either selectively or throughout the system.
7. Alarm and trouble conditions shall be immediately displayed on the control panel alphanumeric display. If more alarms or troubles are in the system, the operator may scroll to display new alarms.

F. Supervision

1. There shall be adequate independently supervised and independently fused notification appliance circuits for alarm, horns, and flashing alarm lamps. Disarrangement conditions of any circuit shall not affect the operation of other circuits.
2. All auxiliary manual controls shall be supervised so that all switches must be returned to the normal automatic position to clear system trouble.
3. Each independently supervised circuit shall include a discrete panel readout to indicate disarrangement condition per circuit.
4. The incoming power to the system shall be supervised so that any power failure must be audibly and visually indicated at the control panel and the remote annunciator.

2.2 MULTIPLE ADDRESSABLE NETWORK (MAPNET)

A. Communication with addressable devices: The system must provide communication with all initiating and control devices individually. All of these devices are to be individually annunciated at the control panel. Annunciation shall include the following conditions for each point:

1. Alarm
2. Trouble
3. Open
4. Short
5. Ground
6. Device Fail/or Incorrect Service/detector in need of cleaning

B. All addressable devices are to have the capability of being disabled or enabled individually.

C. Addressable devices may be multi-dropped from a single pair of wires.

D. A Mapnet Isolator shall be required to isolate each zone of addressable devices. The isolator module shall operate as an addressable device with the same capabilities of enable, disable, and annunciation.

E. The communication format must be a poll/response protocol to allow t-tapping of the wire to addressable devices and be completely digital. A high degree of communication reliability must be obtained by using parity data bit error checking routines for address codes and check sum routines for the data transmission protocol. Systems that do not utilize full digital protocol (i.e. that may use time pulse width methods to transmit data etc.) will not be acceptable.

F. Each addressable device must be uniquely identified by an address code entered on each device at time of installation. The use of jumpers to set address will not be acceptable due to the potential of vibration and poor contact.

G. Wiring types will be approved by the equipment manufacturer. The system must allow up to 2,500 feet wire length to the furthest addressable device.

2.3 FIRE ALARM CONTROL PANEL (FACP)

A. Where shown on the plans provide and install a fire alarm control panel. Construction shall be modular with solid state, microprocessor based electronics. It shall display only those primary controls and displays essential to operation during a fire alarm condition. Although the keypad/keyboard can be used for control (firefighter/emergency) of the entire system; it shall only be used for maintenance purposes. Keyboards or keypads shall not be visible or required to operate the system during fire alarm conditions.

B. A local audible device shall sound during Alarm, Trouble, or Supervisory conditions. This audible device shall sound differently during each condition to distinguish one condition from another without having to view the panel. This audible device shall also sound differently during each keypress to provide an audible feedback (chirp) to ensure that the key has been pressed properly.

1. Primary Keys & Panel Display:

    a. The Control Panel shall have a 2 line x 40 character liquid crystal display which shall be backlit for enhanced readability. So as to conserve battery standby power, it shall not be lit during an AC power failure unless an alarm condition occurs or there is keypad activity.
    b. The display shall support both upper and lower case letters. Lowercase letters shall be used for softkey titles and prompting the user. Uppercase letters shall be used for System Status information. A cursor shall be visible when entering information.

2. Function Keys

    a. Additional field programmable function keys shall be provided to access status data for all system points. As a minimum, the status data shall include Disable/Enable Status, Verification Tallies of Initiating Devices, Acknowledge Status, etc.

3. LED Supervision

    a. All slave module LEDs shall be supervised for burnout or disarrangement. Should a problem occur, the panel shall display the module and the LED location numbers to facilitate location of that LED.

4. Panel Features

    a. The fire alarm control panel shall allow for loading or editing special instructions and operating sequences as required. The FACP is to be capable of on-site programming to accommodate and facilitate expansion, building parameter changes or changes as required by local codes without the need to replace IC chips. All software operations are to be stored in a non-volatile programmable memory within the fire alarm control panel. Loss of primary and secondary power shall not erase the instructions stored in memory.
    b. The ability for selective input/output control functions based on ANDing, ORing, NOTing, timing and special coded operations is to also be incorporated in the resident software programming of the system.
    c. To accommodate and facilitate job site changes, initiation circuits shall be individually configurable on site to provide either alarm/trouble operation, alarm only, trouble only, current limited alarm, no alarm, normally closed device monitoring a non-latching circuit for an alarm verification circuit.
    d. An operator, at the FACP, having a proper access level, shall have the capability to manually control the following for each analog sensor:

        1) Clear peak detection values
        2) Enable or disable the point
        3) Clear verification tally
        4) Control a sensor's relay driver output
        5) Change sensor sensitivity level

    e. It shall be possible to program the control panel to automatically change the sensitivity settings of each analog sensor based on time-of-day and day-of-week

(for example, to be more sensitive during unoccupied times and less sensitive during occupied periods). There shall be seven (7) sensitivity settings available for each photo sensor.

f. The control panel shall have the capability of being programmed for a pre-alarm or two-stage function. This function allows an indication to occur when, for example a 3% sensor reaches a threshold of 1.5% smoke obstruction.

g. At least 500 individually identified sensors as well as conventional initiating device and indicating appliance circuits shall be supported within a single FACP.

5. History Logging

a. The control panel shall have the ability to store a minimum of three hundred (300) events in an alarm log plus a minimum of 300 events in a separate trouble log. These events shall be stored in a battery protected random access memory (RAM).

6. Walk Test with History Logging

a. The system shall be capable of being tested by one person. While in testing mode, the alarm activation of an initiating device circuit shall be silently logged as an alarm condition in the historical data file. The panel shall automatically reset itself after logging of the alarm.

b. The momentary disconnection of an initiating or indicating device circuit shall be silently logged as a trouble condition in the historical data file. The panel shall automatically reset itself after logging of the trouble condition.

c. Optionally, the walk test sequence will have the capability of activating the alarm indicating appliances for a maximum of 2 seconds. If this option is selected, any momentary opening of an initiating or notification appliance circuit wiring shall cause the alarm indicating appliances to sound for 4 seconds to indicate the trouble condition.

d. Should the walk test feature be on for an inappropriate programmable amount of time, it shall revert to the normal mode automatically.

e. The control panel shall be capable of supporting up to eight (8) separate testing groups whereby one group of points may be in a testing mode and the other (non-testing) groups may be active and operate as programmed per normal system operation. After testing is considered complete, testing data may be retrieved from the system in chronological order to ensure device/circuit activation.

f. Should an alarm condition occur from an active point, not in walk test mode, it shall perform all standard programmed alarm sequences.

7. System Trouble Reminder

a. Should a trouble condition be present with the system and the audible trouble signal silenced, the trouble signal shall resound at preprogrammed time intervals to act as a reminder that the fire alarm system is not 100% operational. Both the time interval and the trouble reminder signal shall be programmable to suit the owner's application.

8. Access Levels

a. There shall be a minimum of four (4) access levels. Passcodes shall consist of up to ten (10) digits. Changes to passcodes shall only be made by authorized

personnel. Systems not capable of password protected manual command operations shall provide key operated switches for these functions. Function key switches shall be keyed differently from any other keyed switches or locks used within the system.

b. In order to maintain security when entering a passcode, the digits entered will not be displayed. All key presses will be acknowledged by a local audible momentary tone.

c. When a correct passcode is entered, an "ACCESS GRANTED" message shall be displayed. The new access level shall be in effect until the operator leaves the keypad inactive for ten (10) minutes or manually logs out.

d. Should an invalid code be entered, the operator shall be notified with a message and shall be allowed up to three chances to enter a valid code. After three unsuccessful tries, an "ACCESS DENIED" message shall be displayed.

e. Access to a level will only allow the operator to perform all actions within that level and all actions of lower levels, not higher levels.

f. The following keys/switches shall have access levels associated with them:

1) Alarm Silence
2) System Reset
3) Set Time/Date
4) Manual Control
5) On/Off/Auto Control
6) Disable/Enable
7) Clear Historical Alarm Log
8) Clear Historical Trouble Log
9) Walk Test
10) Change Alarm Verification

g. Acknowledge keys shall also require privileged access to acknowledge points. If the operator presses an acknowledge key with insufficient access, an error message will be displayed. The points will scroll with each key press to view the points on the list, but the points will not get acknowledged in the database.

2.4 EXTERNAL DEVICES

A. Remote LCD Annunciators:

1. In entrance vestibule, main offices and where otherwise shown on drawings, provide and install flush mounted LCD annunciators. The annunciator shall communicate to the control panel over one twisted pair of wire and operating power shall be 24 VDC and be fused at the control panel. Point-wired annunciators will not be considered as equal. Adjacent to the annunciator provide a floor plan graphic.
2. The annunciators that are provided in the building vestibule shall have all control buttons programmed so that they are not operable. The one in the vestibule shall be annunciator only, with no controls.

a. The LCD annunciator shall provide a common alarm and trouble circuit consisting of:

1) Control pushbutton switches for: alarm silence, alarm acknowledge, supervisory acknowledge, trouble acknowledge, system reset, display time and up to four control keys for programmable operation duplicating the control panel switches. A key "enable" switch or password control function shall be provided to activate or deactivate the control switches.
2) Tone Alert - Duplicates the control panel tone alert during alarm and trouble conditions.
3) System trouble LED.
4) Power on LED.
5) An 80 character LCD display. The top line of 40 characters shall be the point label and the second line shall be the device type identifier. The system alarm LED shall flash on the control panel and the remote annunciator until the alarm has been acknowledged. Once acknowledged, this same LED shall latch on. A subsequent alarm received from another zone shall flash the system alarm LED on the control panel and remote annunciator. The LCD display shall show the new alarm information.
6) Alarm silence LED.

b. The annunciator's display shall be backlit for enhanced readability. So as to conserve battery standby power, it shall not be lit during an AC power failure unless an alarm condition occurs or there should be keypad activity.
c. The display shall support both upper and lower case letters. Lowercase letters shall be used for softkey titles and prompting the user. Uppercase letters shall be used for System Status information. A cursor shall be visible when entering information.
d. Under normal conditions, the front panel shall display a "System is Normal" message and the current time and date.
e. Should an abnormal condition be detected, the appropriate LED (Alarm, Supervisory, or Trouble) shall flash. The panel audible signal shall pulse for alarm conditions and sound steady for trouble and supervisory conditions.
f. The LCD shall display the following information relative to the abnormal condition of a point in the system.

1) 40 character custom location label.
2) Type of device (i.e. smoke, pull station, or waterflow).
3) Point status (i.e. alarm, trouble).

3. To accommodate the facilitation of job site changes, the control switches shall have the capability to be programmed on site to provide for manual switch input operation other than their standard purpose.

B. Floor Plan

1. Adjacent to each annunciator (unless otherwise indicated) and at the main control panel provide a floor plan with the following:

a. ¾ x ¾ red colored, extruded, aluminum frame, connected at each of the corners with a screw corner bracket; similar to the type used for picture frames.
b. Provide Plexiglas covering on front.
c. Provide metal back plate.

d. Provide for mounting with screws through the front. Predrill Plexiglas front with smaller holes so that screws are captured inside the unit and cannot fall out, but can be attached into the wall using a narrow blade screwdriver or Allen wrench.
e. Floor plan of the building shall be shown on the floor plan graphic.
f. Divide the building into separate areas and indicate on graphic. Use fire areas indicated on architectural drawings or building units if building does not have multiple fire areas. Label areas and indicate area in device address.
g. The floor plan graphic shall be black with each area indicated in black.
h. For multiple floors or larger buildings, provide additional displays, if required, so as to provide readability.
i. This unit is to be supplied by the contractor or fire alarm equipment supplier. Drawing of this unit must be shown in review drawings.

C. Visual Flashing Lamps (Xenon Strobe) dry locations:

1. Visual indicating appliances shall comprise a Xenon flashtube and be entirely solid state. These devices shall be UL listed and comply with current ADA requirements, producing the candela listings as indicated below and be capable of either ceiling or wall mounting. Visual units shall incorporate a built-in reflector to improve lighting characteristics.
2. Candela requirements per NFPA 72 as shown on drawings.
3. The LEXAN lens shall be pyramid shaped to allow better visibility. Provide vandal resistant unit. Visual units shall be incorporated as part of every horn assembly and shall be individually mounted where shown on the drawings.
4. The location of the visual indicator is approximate. Install in the room, at any location, as long as the indicator can be viewed from all usable spaces within the room. Mount visual indicator where it does not conflict with other wall finishes or other equipment.
5. Color shall be white interior; red exterior.

D. Visual Flashing Lamps (Xenon Strobe) Wet Locations: Provide where shown on plans. Equipment to be the same as listed above, except wet location model.

E. Audible/Visual Notification Alarm Appliance (horn/ strobe) dry location:

1. Visual units shall provide a common enclosure for the fire alarm audible and visual alarm devices. The unit shall be complete with a tamper resistant, Pyramidal shaped lexan lens with "Fire" lettering visible from a 180 degree field of view. The front panel or bezel which is constructed of UL Listed Noryl, may be inverted so that the lens is below the audible device.
2. Integral Xenon strobe shall be adjustable from 1 to 3 flashes per second.
3. Candela requirements per NFPA 72 as shown on drawings.
4. Xenon strobe shall provide 4 wire connection to insure properly supervised in/out system connection. Unit shall be complete with all mounting hardware including backbox, for semi-flush mounting. For existing construction, surface mounted unit may be provided. All surface hardware shall be painted to match device color. Visual unit shall be UL Listed for its intended purpose and comply with current ADA 1971 requirements. Units shall be vandal resistant.
5. Color shall be white interior; red exterior.

F. Audible/Visual Notification Alarm Appliances (horn/ strobe) wet location: Provide where shown on plans. Equipment to be the same as listed above, except wet location model.

G. Addressable Peripheral Devices: The system control panel, over its two wire multi-drop channel, must be capable of communicating with the types of addressable devices specified below. Addressable devices will be located as shown on the drawings.

H. Addressable Pull Stations:

1. Addressable pull stations will contain electronics that communicate the station's status (alarm. normal) to the control panel over two wires which also provide power to the pull station. The address will be set on the station. The stations will be manufactured from high impact red Lexan. Lettering will be raised and painted white. The station will mechanically latch upon operation and remain so until manually reset by opening with a key common to all systems locks. Pull stations shall be double action, push/pull.
2. The front of the station is to be hinged to a backplate assembly and must be opened with a key to reset the station. The key shall be common with the control panels. Stations which use Allen wrenches or special tools to reset will not be accepted. The station shall consist of high impact Lexan, red in color.
3. The addressable manual station shall be capable of field programming of its "address" location on an addressable signaling line circuit.
4. There shall be no limit to the number of stations, detectors or Zone Adapter Modules, which may be activated or "in alarm" simultaneously.
5. The addressable manual station shall be Underwriter's Laboratories, Inc. listed.
6. Where noted on drawings, provide fire alarm station lift covers: STI or equal, telephone number (248) 673-9898.

    a. Flush fire alarm pull station, without lift cover alarm: Stopper II STI 1200

I. Smoke Sensors:

1. The smoke sensors shall be of the photoelectric type and shall communicate actual chamber values to the system control panel.
2. The smoke sensors and bases shall be listed to UL Standard 268 and documented compatible with the control equipment to which they are connected. The sensors shall be listed for both ceiling and wall mount applications.

J. Photoelectric Sensor Head:

1. The sensor shall be of the solid state photoelectric type and shall contain no radioactive material. They will use a pulsed infrared LED light source and be sealed against rear air flow entry.
2. The photoelectric type sensor shall be a plug-in unit which mounts to a twist-lock base.
3. The sensor shall fit into a base that is common with both the heat sensor and ionization type sensor and shall be compatible with other addressable detectors, addressable manual stations, and addressable Zone Adaptor Modules on the same circuit.
4. There shall be no limit to the number of sensors, stations or Zone Adaptor Modules which may be activated or "in alarm" simultaneously.
5. Each sensor will be capable of sensing up to (7) sensitivity levels ranging between .5% and 3.7%.
6. The photoelectric sensor shall have a fine 30 mesh insect screen.
7. The sensor electronics shall be completely shielded to protect against false alarms from EMI and RFI (Electromagnetic and Radio Frequent Interference).

K. Thermal (Heat) Sensor Head:

1. The Thermal type sensor shall be a plug-in unit which mounts to a twist-lock base.
2. The sensor shall be a combination rate of rise/fixed temperature sensor U.L. listed as a rate compensated heat detector unless otherwise indicated on plan.
3. The sensor shall fit into a base that is common with both photoelectric and ionization sensors and shall be compatible with other addressable detectors, addressable manual stations, and addressable Zone Adapter Modules on the same circuit.
4. There shall be no limit to the amount of sensors, stations or Zone Adapter Modules, which may be activated or "in alarm" simultaneously.
5. Each sensor is capable of operating at a selectable rate of rise operation of 15 or 20° Fahrenheit per minute and is self-restorable.
6. Each sensor is capable of fixed temperature operation selectable for either 117 or 135° Fahrenheit, independent of the rate of rise setting.
7. Each sensor can be configured for utility monitoring and capable of sensing temperature between 32 and 158° Fahrenheit.
8. Where 200° F fixed temperature heat detector is noted on plan, as an option, provide conventional heat detector with addressable control module in lieu of addressable 200° F fixed heat detector.

L. Photoelectric Duct Detector:

1. The sensor shall be photoelectric type, which obtains its operating power from the supervisory current in the fire alarm detection loop.
2. Sensors shall be of the solid state photoelectric type and shall operate on the light scattering, photodiode principle. To minimize nuisance alarms, detectors shall have a minimum 30 mesh insect screen and be designed to ignore invisible particles or smoke densities that are below the factory set point. No radioactive material shall be used.
3. Detector construction shall have a mounting base with a twist-lock sensing head. The locking feature must be field removable when not required. Contact between the base and head shall be of the bifurcated type utilizing spring type, self-wiping contacts. Removal of the sensor head shall interrupt the supervisory current of the fire alarm detection loop and cause a trouble signal at the control panel. Detector design shall provide compatibility with other addressable detectors, addressable manual stations and addressable zone adapter modules on the same circuit.
4. For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing front cover.
5. Auxiliary DPDT relays and/or remote LED alarm indicators with key test switch shall be provided for each duct detector.
6. Activation of relays shall be performed through the system program. Tracking the alarm only condition of the duct sensor is not acceptable.
7. Each sensor base shall contain a LED that will flash each time it is scanned by the control panel (once every 4 seconds). When the control panel determines that a sensor is in the alarm or a trouble condition, the control panel shall command the LED on that sensor's base to turn on steady indicating the abnormal condition. Sensors which do not provide a visible indication of an abnormal condition at the sensor location shall not be acceptable.
8. Each sensor shall be scanned by the control panel for its type identification to prevent inadvertent substitution of another sensor type. The control panel shall operate with the installed device but shall initiate a "Wrong Device" trouble condition until the proper type is installed or the programmed sensor type is changed.
9. The sensor's electronics shall be immune from false alarms caused by EMI and RFI.

10. Provide a remote alarm/power LED key test switch indicator for each duct smoke detector that is more than 10’ high or cannot be seen(NFPA Code). Indicators to be mounted at 48" above finished floor into the area where the smoke detector is located.
11. In mezzanine areas or other areas where air handlers are located, provide remote indicator near doorway or stairway entering into the room. Installation of remote detector shall be coordinated with other equipment in the mechanical equipment room. Every unit shall be equipped with an engraved nameplate indicating which air handler it handles. Every smoke detector on the air handler or the air handler shall have a 1" x 3" engraved label clearly indicating which air handler it is. If the remote indicator is not shown on the floor plans, get direction from the Architect or Engineer to determine the location of the detector.

M. Addressable Sensor Bases:

1. Sensor bases shall be compatible with all models of sensors. Each base is capable of communicating sensor values to the panel if a "wrong device type" trouble condition is present. The panel will continue to monitor for alarms and troubles using the default setting for the wrong device until the proper type is installed or the program is changed.
2. Each sensor base shall contain a LED that will flash each time it is scanned by the control panel (once every 4 seconds). When the control panel determines that a sensor is in the alarm or a trouble condition, the control panel shall command the LED on that sensor's base to turn on steady indicating the abnormal condition. Sensors which do not provide a visible indication of an abnormal condition at the sensor location shall not be acceptable.
3. Each sensor base shall contain a magnetically actuated test switch to provide for easy alarm testing at the sensor location.

    a. The sensor base shall annunciate power-on, alarm and trouble conditions locally at the base.
    b. In addition, where shown on plans, the sensor base shall remotely annunciate power-on, alarm and trouble conditions using a remote LED indicator.

4. Sensor Base with Relay:

    a. Where shown on plans, for elevator smoke detectors, and for smoke detectors associated with smoke doors, the sensor base shall include a control relay for programmable function.
    b. The relay shall not take any additional addressable device capacity.
    c. The relay shall provide (2) sets of Form C contacts rated 3 amps and powered from the system 24 VDC and operate in battery standby.
    d. Relay shall mount in same electrical box the sensor base is installed on.
    e. Wire relay to interconnect with magnetic hold opens where shown on drawings. The smoke detector shall be configured such that the smoke detector will directly control the magnetic hold-open devices and will cause only those doors associated with the detector to close. All doors shall not close at once.

N. Fire Alarm Control Multiplex Operation:

1. The system shall be capable of providing multiplex operation by using the fire alarm control panel as a central processing unit (CPU) that provides Style 4 or Style 7 communications up to 31 remote transponders. All data communications wiring between the CPU and transponders shall be supervised for opens, shorts, and grounds. The remote

transponders shall be capable of containing up to 31 selectable fire alarm control panel modules to provide the following functions:

a. Interface modules, each capable of communicating to up to 127 devices via the Multiple Addressable Peripheral detectors, smoke sensors, and other addressable initiating and control devices as described in section 9.
b. Power supply and charger capable of providing 8 amps of system power and capable of charging up to 50 AH batteries powered by 120 HVA, 60 Hz.
c. Initiating circuits for Style B or Style A operation.
d. Notification Appliance circuits for Style Y or Style Z.
e. Auxiliary control relay circuits with feedback to monitor circuit connection.
f. Isolator module to provide line isolation of shorted segments.
g. Input/Output Graphic Driver Interface.
h. Front panel mounted status indicating LEDs including with provision for selecting and changing LED color on-site.
i. Momentary switches with status indicating LEDs.
j. Three position (on-off-auto) maintained switches with status indicating LEDs.
k. Packaging shall include solid door with beige paint.

2.5 PROGRAMMABLE MODULES

A. Programmable Input Modules shall be the used for monitoring of water flow, valve tamper, and non-addressable devices.

B. These modules shall be addressable and shall be provided for interfacing open and direct contact devices to the addressable signaling circuit.

C. Provide addressable output modules. These shall be for operating non-addressable devices, such as air handler starters, smoke dampers, security equipment, magnetic holders, and other devices requiring fire alarm system control.

D. For non-supervised control.

1. This type of addressable device will provide double pole double throw relay switching for loads up to 120 VAC. It will contain easily replaceable 2 amp fuses, one on each common leg of the relay.
2. The AM shall be supervised and uniquely identified by the control panel. Device identification shall be transmitted to the control panel for processing according to the program instructions. Should the AM become non-operational, tampered with, or removed, a discrete trouble signal, unique to the device, shall be transmitted to, and annunciated at, the control panel.
3. The AM shall be capable of being programmed for its "address" location on the addressable device signaling circuit. The AM shall be compatible with addressable manual stations and addressable detectors on the same addressable circuit.
4. All devices will be supervised for trouble conditions. The system control panel will be capable of indicating the type of trouble condition (open, short, device missing/failed). Should a device fail, it will not hinder the operation of other system devices. Should a problem occur on a particular wire run, it will not affect other wire runs.

2.6 AHU SYSTEM INTERFACE

A. Duct Smoke Detectors and Addressable Control Modules, or Supervised Remote Relays shall be provided as specified below. Duct Smoke Detectors shall be installed in compliance with the manufacturer's recommendations. Each Addressable Control Module or Supervised Remote Relay for AHU and / or Fan shutdown shall be installed within 3 feet of the Temperature Control Panel to which it is connected. The Division 26 EC shall provide all wiring and terminations required for shutdown of the specified AHUs / Fans.

B. The Addressable Control Modules or Supervised Remote Relays provided for this purpose shall be provided with DPDT output contacts. One SPDT set of the DPDT contacts shall be utilized for the specified shutdown function. The second SPDT set of the DPDT contacts shall be available for connection to the temperature controls, to indicate that unit shutdown – due to Duct Smoke – has occurred.

C. The control panel shall provide an output alarm interface to the air handling/energy management system controllers, which in turn shall perform automatic function as specified in the applicable sections of Division 15.

D. An override feature / control switch shall be provided which shall prevent shutdown of AHUs when this function is active.

E. Programming: (This shall apply to All AHUs / Fans listed above):

1. Upon actuation of a duct smoke detector installed at the AHU, the AHU shall shut down.
2. The associated fan shall be shut down only upon actuation of the duct smoke detector associated with the particular unit.
3. All such AHUs / fans shall remain shut down, until a valid System Reset occurs.

2.7 SPRINKLER SYSTEM SUPERVISORY SERVICE

A. The control panel shall have a dedicated supervisory service LED and a dedicated supervisory service acknowledge switch.

B. The activation of any standpipe or sprinkler valve supervisory (tamper) switch shall activate the system supervisory service audible signal and illuminate the LED at the control panel and FAAP. The panel shall provide differentiation between valve tamper activation and opens and/or grounds on the initiation circuit wiring.

1. Each Valve Tamper Switch shall be individually monitored, except for pairs of valves associated with the "Double Check Valve". The Descriptors, which are used to describe these tamper switches, shall identify the function or sprinkler zone associated with the valve.
2. Each Flow Switch and Pressure Switch, which are used to indicate discharge, shall be individually monitored, and shall cause the actuation of the proper Alarm Sequence corresponding to the location of the Sprinkler Zone. The Descriptors, which are used to describe these flow and pressure switches, shall identify the associated sprinkler zone. In other words – describe where the water should be going, not the location of the Flow or Pressure Switch.

3. The function of each valve, flow switch, and pressure switch, associated with the Fire Protective Sprinkler System shall be available, upon request by the successful Electrical Bidder, from Owner, the Fire Protection Engineer or Fire Protection Contractor.
4. The Fire Pump shall be monitor for presence of power, lose of power and phase reversal

C. Pressing the supervisory service acknowledge key will silence the supervisory audible signal while maintaining the supervisory service LED "on" indicating the off-normal condition.

D. Restoring the valve to the normal position shall automatically reset the tamper indication.

E. Supervisory Status conditions may be programmed as self-restoring – once the valve has been fully opened, or the monitored suppression system has been returned to service, a “restored to normal” message shall appear at the FACP and FAAP, and shall also be logged to the system history log.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify surfaces and areas are ready to receive work.

B. Verify field measurements are accurate and shown on drawings.

C. Verify proper power connections are installed.

D. Proceed with installation only after unsatisfactory conditions are corrected.

E. All wiring shall test free from grounds and shorts.

3.2 FIELD MEASUREMENTS

A. Field verify proper mounting heights of all devices.

B. Field verify surfaces which equipment will be located. Verify adequate room for recessed equipment. Adjust locations to satisfy field measurements.

C. Mounting heights as shown on drawings and details. Coordinate final locations with on-site architect prior to rough-in.

3.3 DELIVERY, STORAGE & HANDLING

A. Receive, sign for, and store all equipment in this section.

B. Maintain original quality and condition of equipment while it is in storage.

3.4 INSTALLATION

A. General:

1. The complete installation shall be done in a neat, workmanlike manner in accordance with all applicable codes and the manufacturer's recommendations.
2. Install all materials, assemblies and equipment in strict accordance with manufacturer's recommendations and instructions. Consult manufacturer for all wiring diagrams, schematics, sizes, outlets, etc. before installing.
3. Start of installation shall not begin until areas are broom clean, properly lighted, exterior enclosing walls in place, exterior windows glazed, roof completely installed to prevent weather damage to equipment, and written notice received by ESC from Architect stating that these conditions exist at building site.
4. All rough-in, boxes, conduit, and 120V power to be provided by Division 26 contractor. Coordinate all rough-in requirements, 120V power locations, and conduit stub locations with Division 26 contractor prior to start of any work. Provide any special rough-in boxes to the Division 26 contractor prior to performing any work.
5. Install power supplies as required based on equipment per manufacturer. Coordinate power requirements, rough-in, and location with electrical contractor.

B. Cleaning:

1. Prior to turning the system over to the Owner, the system shall be physically cleaned.
2. All appearance defects shall be carefully and professionally touched up so that the equipment is in "factory new" condition.
3. At the completion of the work, remove from the building and the premises all rubbish and debris resulting from the work.

C. System Wiring

1. The system wiring and installation shall be in compliance with applicable codes, project drawings and as required by the manufacturer. All wiring shall be color coded, tagged and checked to assure that it is free from shorts and grounds. Provide record drawings of installation.
2. Note: Electrical contractor shall provide duxseal at each smoke detector to seal the conduit.
3. All wiring shall be installed in conduit unless specifically noted to be allowed in free-air.

D. Raceways

1. NOTE: ALL FIRE ALARM SYSTEM WIRING SHALL BE INSTALLED WITHIN METALLIC CONDUIT UNLESS SPECIFIED.
2. All wiring shall be in a conduit system separate from other building wiring. See Section 26 05 34 - Raceways for specifications.
3. All wiring shall be in minimum ½" steel raceway.
4. 40% fill factor shall be applied to all conduit sizes.
5. The contractor shall size conduit and boxes by circular mil size of each cable in each conduit or box. The circular mil sizing can be found on the manufacture's spec sheet, then use the NEC codebook to make calculation to follow NEC Table 314-16(A) for box fill and Chapter 9 for conduit fill.
6. There shall be no sharp edges with installed materials.

7. Use only identified conduit entries or request approval for other penetrations in cabinets; (certain areas require clear space for interior components / batteries). Cabinet shall be grounded to either a cold water pipe or grounding rod.

E. Free Air Wiring:

1. A/E shall identify all plenum areas on the drawings and install the proper wiring type.
2. All wiring shall be run “free-air”, in conduit or in surface raceway. "Free-air" wiring for horizontal cable runs of Power Limited Fire Alarm (PLFA) DC circuits as approved by the Engineer shall be the method of installation in the following areas:

    a. Above finished accessible ceiling.

3. All other wiring shall be installed in conduit or surface metal raceway. Surface metal raceway shall be used on finished walls and ceilings along with the manufacturers designed boxes and fittings for the raceway.
4. Where installed “free-air”, installation shall consider the following:

    a. Cable shall run at right angles and be kept clear of other trades work.
    b. Cables shall be supported according to code utilizing "Bridal-type" mounting rings or J hooks anchored to ceiling concrete, piping supports or structural steel beams. Rings shall be designed to maintain cables bend to larger than the minimum bend radius (typically 4 x cable diameter).
    c. Supports should be spaced at a maximum 4-foot interval unless limited by building construction. If cable "sag" at mid-span exceeds 12-inches, another support shall be used.
    d. Cable shall never be laid directly on the ceiling grid.
    e. Cables shall not be attached to or supported by, existing cabling, plumbing or steam piping, ductwork, ceiling supports or electrical or communications conduit.

5. A coil of 2 feet in each cable shall be placed in the ceiling at each “free-air” wired fire alarm device. These "service loops" shall be secured at the last cable support before the cable reaches the device and shall be coiled from 100% to 200% of the cable recommended minimum bend radius.
6. Devices wired with conduit shall be provided with an 8-inch wire tail at each device box and 36-inch wire tails at the FACP and FAAP.
7. To reduce or eliminate EMI, the following minimum separation distances from <480V Power lines shall be adhered to:

    a. Twelve (12) inches from power lines of <5-kVa.
    b. Eighteen (18) inches from high voltage lighting (including fluorescent).
    c. Thirty-nine (39) inches from power lines of 5-kVa or greater.
    d. Thirty-nine (39) inches from transformers and motors.

8. All cable shall be free of tension at both ends. In cases where the cable must bear some stress, Kellum grips may be used to spread the strain over a longer length of cable.
9. Manufacturers minimum bend radius specifications shall be observed in all instances. Care should be taken in the use of cable ties to secure and anchor the station cabling. Ties should not be over tightened as to compress the cable jacket. No sharp burrs should remain where excess length of the cable tie has been cut.

10. All vertical cable extensions to fire alarm devices located below the finished ceiling shall be in conduit.
11. It is the contractors' responsibility to survey the site and include all necessary costs to perform the installation as specified. This includes any modifications required to route and conceal horizontal distribution wiring.
12. Beginning installation means contractor accepts existing conditions.
13. Contractor shall furnish all required installation tools to facilitate cable pulling without damage to the cable jacket. Such equipment is to include, but not limited to, sheaves, winches, cable reels, cable reel jacks, duct entrance tunnels, pulling tension gauge and similar devices. All equipment shall be of substantial construction to allow steady progress once pulling has begun. Makeshift devices, which may move or wear in a manner to pose a hazard to the cable, shall not be used.
14. All cable shall be pulled by hand unless installation conditions require mechanical assistance. Where mechanical assistance is used, care shall be taken to ensure that the maximum tensile load for the cable as defined by the manufacturer is not exceeded. This may be in the form of continuous monitoring of pulling tension, use of a “break-away” or other approved method.
15. The contractor will be responsible for identifying and reporting to the Site Coordinator(s) any existing damage to walls, flooring, tiles and furnishings in the work area prior to start of work. The Contractor must repair all damage to interior spaces caused by the installation of cable; raceway or other hardware. Repairs must match preexisting color and finish of walls, floors and ceilings. Any contractor-damaged ceiling tiles are to be replaced to match color, size, style and texture.
16. Where unacceptable conditions are found, the Contractor shall bring this to the attention of the construction supervisor immediately. A written resolution will follow to determine the appropriate action to be taken.
17. Qualified personnel utilizing state-of-the-art equipment and techniques shall complete all installation work. During pulling operation an adequate number of workers shall be present to allow cable observation at all points of duct entry and exit as well as the feed cable and operate pulling machinery.
18. Cable pulling shall be done in accordance with cable manufacturer’s recommendations and ANSI/IEEE C2 standards. Manufacturer’s recommendations shall be a part of the cable submittal. Recommended pulling tensions and pulling bending radius shall not be exceeded. Any cable bent or kinked to radius less than recommended dimension shall not be installed.
19. Avoid abrasion and other damage to cables during installation.
20. Pulling Lubricant may be used to ease pulling tensions. Lubricant shall be of a type that is non-injurious to the cable jacket and other materials used. Lubricant shall not harden or become adhesive with age.
21. A pull cord (nylon; 1/8” minimum) shall be co-installed with all cable installed in any conduit.

F. Conductors

1. All wire and cable associated with this system shall be as required by the equipment manufacturer. The following information is intended for estimating purposes only. However, the minimum wire gauges and colors specified shall be strictly adhered to. All cable shall be installed as per NEC Article 760.
2. Type FPL wiring is required if the system is run in conduit or 'free-air’.
3. All initiation and notification circuit cabling shall be listed Type FPL (300V) in accordance with NEC article 760."

4. All cables and wires #14 AWG and larger shall be stranded.
5. Fire alarm wiring shall be held in place at the device box, by means of a two-screw connector, (do not use squeeze or crimp type connectors).
6. All wiring shall be completely supervised. In the event of a primary power failure, disconnected standby battery, disarrangement of any components, any open circuits or grounds in the system, an audible and visual trouble signal shall be activated until the system is restored to normal.
7. All conductors shall be color-coded. Coding shall be consistent through out the facility. Green wire shall be used only for equipment ground.
8. Power wiring shall be #12 AWG.
9. Fire Alarm Control Panel, and Annunciator Panel shall have #6 AWG green equipment ground wire.
10. Where fire alarm circuits enter or leave a building, additional transient 75 to 90 volt gas tube protection shall be provided for each conductor.
11. Leave 8-inch wire tails at each device box and 36-inch wire tails at the Fire Alarm Control Panel [and Remote Annunciator Panel(s).
12. Cable for Intelligent detector Loops shall be 18 to 12 AWG twisted pair with a shield jacket installed in ½" conduit. Shield continuity must be maintained and connected to earth ground only at the control panel.
13. SLC wiring must not be in the same conduit with AC power wiring or other high current circuits. T-taps or branch circuit connections are allowed for all class B SLCs.
14. Cable for RS 232-c devices (CRT, PRINTER) shall be dual pair twisted- shielded.
15. Cable for RS 485 devices (Remote Annunciators) shall be twisted-shielded pair (Belden 9841 or equivalent) for the data signal. Power wiring shall be 12 AWG.
16. All splices or connections shall be made within approved junction boxes and with approved fittings. Boxes shall be red and labeled "FIRE ALARM SYSTEM" or “FA” by decal or other approved markings.
17. Horn and strobe circuits shall have separate conductors, and shall operate independently of each other.
18. [Mini horn wiring shall be #14 AWG minimum.]
19. Horn wiring shall be #14 AWG minimum or as recommend by manufacturer.
20. Strobe wiring shall be #14 AWG minimum or as recommend by manufacturer.
21. Tray cable is not acceptable for use as fire alarm system wiring installed in conduit.
22. [All cable run as “Free-Air” shall be Tray Cable rated.]

G. Grounding

1. All equipment shall be grounded in accordance with NEC, these specifications and drawings, and the equipment supplier’s recommendations.

    a. Each cabinet frame shall be grounded. Equipment cabinets shall be bonded directly to the building electrode grounding.
    b. All exterior panels of cabinets shall be bonded to the cabinet frame.
    c. All equipment installed in a cabinet shall be bonded to the cabinet frame.

H. Programming

1. All programming that is required for installation shall be done by this contractor. The contractor shall assume that his vendor is to meet with the owner to determine if there are any extraordinary programming circumstances. The supplier shall go over the entire

sequence of operation of the fire alarm panel and explain what the various programming sequences are.

2. Device addresses shall utilize Owner's room numbers and not room numbers provided on drawings. Include building area in address. See floor plan graphic description for additional information.

I. Junction Boxes

1. Provide fire alarm pull and junction boxes per specification section 26 05 53.

J. Final Testing

1. The completed fire alarm system shall be fully tested in accordance with NFPA by the Contractor in the presence of the Owner's representative and the Engineer. Upon completion of a successful test, certify in writing to the Owner.
2. All wiring shall test free from all grounds and shorts.
3. The completed system shall be tested in accordance with NFPA 72. Provide a certified test report from the manufacturer's representative that the system complies with NFPA and State codes. All technicians performing work on this project shall be factory trained and at minimum, NICET level two certified in fire alarm systems.
4. Fill out the fire alarm system checklist included as a part of this specification. This checklist shall be included with the final O&M operation manual and will be required prior to final payment being made on this equipment.

3.5 MOUNTING OF SMOKE DETECTORS

A. Smoke detectors shall not be installed until final room finishes and carpeting have been laid. As an option to this, the contractor may install the smoke detector, but it must be protected by a plastic bag to prevent dust entering the smoke detector. Install the smoke detectors in this manner to prevent erroneous alarms. If smoke detectors are installed prior to final room finishes being completed and floor finishes being installed, this contractor shall bear the expense of returning the smoke detectors to the factory for cleaning and recalibration.

3.6 MAGNETIC DOOR HOLDER

A. Coordinate the actual mag hold locations with doors and other wall obstructions. Provide appropriate flush mounted junction box. Be responsible for mounting plate onto doors. Provide appropriate plate mounting hardware (stainless steel) or to match other door hardware.

3.7 OWNER TRAINING

A. Provide complete operator training for the Owner's personnel.

B. Provide two (2) four hour training sessions on consecutive days at times set by the Owner. These should be scheduled as part of the Owner's pre-occupancy transition training.

C. Provide a video tape training which can be used by the Owner for training new employees. This tape shall be carefully organized and segmented so that training may be given on the complete system, or on specific functions as may be appropriate.

D. Use submitted Operations & Maintenance manuals as reference during this demonstration and tour.

E. Have owner sign certificate stating that he has received instruction on the fire alarm equipment; see spec section 26 05 04.

3.8 SPARE EQUIPMENT

A. Provide the following spare parts:

1. Provide 2 spare room smoke detectors.
2. Provide 2 spare duct smoke detectors.
3. Provide 1 spare pull station.
4. Provide 2 spare horn/strobe.
5. Provide 2 spare strobes.

END OF SECTION 283100

FIRE ALARM SYSTEM STARTUP CHECKLIST

Date _____

Building Name _____

Facility Owner _____

Installing Contractor _____

Equipment Supplier _____

Equipment Manufacturer _____

Factory Authorized Technician _____

Each fire alarm pull station must be individually tested for system activation and proper zone annunciation. This was done and tested and is in compliance.
Yes _____ No _____ NA _____

Each room smoke detector must be individually tested for system activation and proper zone annunciation and remote indicator operation. This was done and tested and is in compliance.
Yes _____ No _____ NA _____

Each heat detector was individually tested for system activation and proper zone annunciation. This was done and tested and is in compliance. Yes _____ No _____ NA _____

Each duct detector was individually tested for fire alarm system activation, and air handler shut down. Only that air handler protected by a smoke detector shall shut down. This was done and tested and is in compliance. Yes _____ No _____NA _____

Each fire door with magnetic hold opens and ceiling mounted detectors was tested for fire alarm activation, door closure and proper zone annunciation. Note that this shall be tested so that only those doors that are connected with the local smoke detectors are to close; no other doors are to close. This was done and tested and is in compliance. Yes _____ No _____ NA _____

Elevator smoke detectors: The elevator smoke detector system was tested for proper elevator control, fire alarm system activation, and zone annunciation. This was done and tested and is in compliance. Yes _____ No _____NA _____

I hereby certify that the fire alarm system was tested as indicated above. It was found to be operating and complies with State and NFPA codes.

Signed _____ Printed Name _____

SECTION 31 10 00 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Section 312000 – Earth Moving

C. Section 312500 – Erosion and Sediment Control

D. Geotechnical Engineering Services Report for the Public Safety Building, Prairie du Chien, Wisconsin prepared by Professional Services Industries, Inc., dated May 7, 2024.

1.2 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.

2. Clearing and grubbing.

3. Removing above- and below-grade site improvements as noted on the engineering plans.

4. Erosion and sedimentation control.

1.3 DEFINITIONS

A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects larger than 2 inches in diameter; and free of weeds, roots, toxic materials, or other non-soil materials.

D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site to discuss the phasing of the construction/demolition/site clearing.

1.5 MATERIAL OWNERSHIP

A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials, including trees to be removed, shall become Contractor's property and shall be removed from Project site.

1.6 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or video recordings.

2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.

B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.7 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.

2. Provide alternate routes around closed or obstructed trafficways if required by Owner or authorities having jurisdiction.

B. Utility Locator Service: Notify Digger’s Hotline for area where Project is located before site clearing.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

B. Site Clearing Materials Suitable for Site Conditions:

1. Erosion control.

2. Siltation control.

3. Dust control materials.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 EROSION AND SEDIMENTATION CONTROL

A. Provide erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements Erosion Control section of these specifications.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion and sedimentation control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.

1. Arrange with utility companies to shut off utilities where necessary to perform the work.

B. Locate, identify, and disconnect utilities indicated to be abandoned in place.

C. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect and Owner not less than two (2) days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without Architect's and Owner’s written permission.

D. Excavate for and remove underground utilities indicated to be removed.

3.4 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.

2. Grind down stumps and remove roots larger than 2 inches in diameter, obstructions, and debris to a depth of 18 inches below exposed subgrade.

3. Chip removed tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches and compact each layer to a density equal to adjacent original ground.

3.5 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.

2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.6 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

B. Burning tree, shrub, and other vegetation waste is not permitted.

END OF SECTION 311000

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Standard Specifications for Sewer and Water Construction in Wisconsin (Standard Specifications)

C. Standard Specifications for Highway and Bridge Construction, latest edition (State Specification)

D. Geotechnical Engineering Services Report for the Public Safety Building, Prairie du Chien, Wisconsin prepared by Professional Services Industries, Inc., dated May 7, 2024.

1.2 SUMMARY

A. Section Includes:
1. Excavating and filling for rough grading the Site.
2. Preparing subgrades for slabs-on-grade, foundations, sidewalks, pavement.
3. Excavating and backfilling for buildings and structures.
4. Excavating and backfilling for retaining walls.
5. Drainage course for concrete slabs-on-grade.
6. Subbase course for concrete walks and pavements.
7. Subbase course and base course for asphalt paving.
8. Subsurface drainage backfill for walls and trenches.
9. Excavating and backfilling trenches for utilities and pits for buried utility structures.

B. Related Requirements:
1. Section 311000 "Site Clearing" for site stripping, grubbing, removal of above- and below-grade improvements and utilities.
2. Section 321216 “Asphalt Paving”
3. Section 321300 “Rigid Paving”
4. Section 312500 “Erosion and Sediment Control”

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving or rigid paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated. Removal of material such as topsoil, topsoil fill, vegetation, trees, roots, and other unsuitable materials under all structural areas including pavement.

G. Fill: Soil materials used to raise existing grades.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

J. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

K. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.4 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct pre-excavation conference at Project site.

1. Review methods and procedures related to earthmoving, including, but not limited to, the following:

a. Personnel and equipment needed to make progress and avoid delays.
b. Coordination of Work with utility locator service.
c. Coordination of Work and equipment movement with the locations of tree- and plant-protection zones.
d. Extent of trenching by hand or with air spade.
e. Field quality control.

1.5 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Utility Locator Service: Notify Digger's Hotline for area where Project is located before beginning earth-moving operations.

C. Do not commence earth-moving operations until erosion- and sedimentation-control measures specified in the Erosion Control notes shown on the plans are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

2. Unsatisfactory soils as noted in the geotechnical report.

D. Base Course: Follow Section 305 of the State Specifications.

E. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.

B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

2. Contractor shall prepare all subgrade areas not covered by buildings or pavement to an elevation 6-inches below the finish grade.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines and required elevations to achieve final surface elevations.

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated lines and required depths to achieve proposed pipe and structure elevations.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: In accordance with the Standard Specifications.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

3.8 SUBGRADE INSPECTION

A. Notify Architect/Engineers/Owner when excavations have reached required subgrade.

B. If Architect/Engineer/Owner determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade pavements in the parking lot to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades. Excavate soft material and replace with crushed aggregate material to achieve acceptable proof roll.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.9 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.10 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring, bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.11 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. All utility trenches under pavement to be filled w/ granular fill or better. Compact trench material in 4" lifts with plate compactor. Fill within trenches to be compacted to a minimum density of 95 percent of the maximum dry density as determined by ASTM D-1557 (Modified Proctor).

C. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

D. Backfill voids with satisfactory soil while removing shoring and bracing.

E. Warning Tape: Install warning tape directly above utilities, 12 inches below finished grade.

3.12 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use engineered soil material.
3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
5. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.13 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.14 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.

3.15 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1 inch.
3. Pavements: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.16 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:

1. Place base course material over subbase course under hot-mix asphalt pavement.
2. Shape subbase course and base course to required crown elevations and cross-slope grades.
3. Place subbase course and base course 6 inches or less in compacted thickness in a single layer.
4. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
5. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight.

3.17 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and re-compact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.

1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

3.19 FIELD QUALITY CONTROL

A. Testing Agency: The contractor will be responsible for all soils compaction and geotechnical tests required for earth moving.

END OF SECTION 312000

SECTION 312500 - EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. The requirements of the Contract Documents, including the General Conditions shall apply to this Section except as modified herein.

B. The work performed under this Section includes the furnishing of all materials, parts, labor, tools, equipment, and supervision necessary for the installation of temporary and permanent erosion and sedimentation control systems and temporary and permanent slope protection systems.

C. Construction, by other trades and other sections, will be occurring concurrent with work by this Section. Cooperation in the scheduling of work, delivery of materials, and storage of same will be required.

1.2 RELATED SECTIONS

A. Section 311000 – Site Clearing

B. Section 312000 – Earth Moving

1.3 ENVIRONMENTAL REQUIREMENTS

A. Protect adjacent properties; any identified endangered or threatened species or critical habitat, any identified cultural or historic resources, and receiving water resources from erosion and sediment damage until final stabilization.

1.4 SUBMITTALS

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.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Sediment control devices as specified on the Construction Drawings and in accordance with the Wisconsin Construction Site Best Management Practice Handbook, latest edition.

B. Silt Fence installation and materials shall conform to Wisconsin Department of Natural Resources (WDNR) Conservation Standard 1056.

C. Placement of temporary seed, sod and ground covers for the establishment of vegetation as specified on the Construction Drawings. The composition of temporary seed mixture for right-of-ways shall conform to 630.2.1.5.2 of the WISDOT Standard Specifications. Use winter wheat or rye for fall plantings starting after September 1.

D. Temporary mulches as specified on the Construction Drawings.

E. All installation and maintenance of erosion and sedimentation control practices shall be in accordance with the applicable WDNR Technical Standards.

F. Storm Drain Inlet Protection, Rip Rap as specified on the Construction Drawings.

G. Provide material approved for use in the Wisconsin Department of Transportation Product Acceptability List (PAL).

PART 3 - EXECUTION

3.1 PREPARATION

A. Review the Construction drawings.

B. Place erosion and sedimentation control systems in accordance with the drawings or as may be dictated by site conditions in order to maintain the intent of the specifications and permits.

C. Changes to the drawings shall be implemented as site conditions change. Changes made during construction shall be noted on the Drawings and posted in the job trailer.

D. Owner has the authority to limit surface area of erodible materials exposed by clearing and grubbing, excavation, borrow, and embankment operations and to direct Contractor to provide immediate permanent or temporary pollution control measures.

E. Maintain temporary erosion and sedimentation control systems as dictated by site conditions, indicated in the construction documents, or as directed by governing authorities or the Owner to control sediment until final stabilization. Contractor shall respond to maintenance or additional work ordered by Owner or governing authorities immediately, but in no case, within not more than 48 hours if required at no additional cost to the Owner.

F. Contractor shall incorporate permanent erosion control features, paving, permanent slope stabilization, and vegetation into the project as soon as practical to minimize the need for temporary controls.

G. Permanently seed and mulch cut slopes as excavation proceeds to the extent considered desirable and practical.

H. Unless required within a shorter timeframe by the General Permit, disturbed areas that will not be graded or actively worked for a period of 14 days or more, shall be temporarily stabilized as work progresses with vegetation or other acceptable means. In the event it is not practical to seed areas, slopes must be stabilized with mulch and tackifier, bonded fiber matrix, netting, blankets or other means to reduce the erosive potential of the area.

3.2 MAINTENANCE

A. Erosion control devices shall be inspected weekly and within 24 hours after each rainfall that produces 0.5 inches of rain or more during a 24-hour period. Repair or replacement shall be made immediately.

B. Sediment deposits should be removed after each storm event. Sediment deposits shall be removed when deposits reach one-half the height of the fence or bale.

C. Remove all materials tracked onto public roads daily.

3.3 TEMPORARY SEEDING

A. Areas such as denuded locations, soil stockpiles, dikes, dams, sides of sediment basins, temporary roadbanks, etc. that are not to be fine graded for periods longer than seven days, are to be temporarily seeded. Temporary seed mixtures shall conform to the requirements of Section 630.2.1.5.1.2. Oats shall be used in spring and summer plantings. Winter wheat or rye shall be used for fall plantings after September 1.

3.4 REMOVAL

A. After growth has been established with 100 percent of the area being covered with vegetation at a density of 70 percent and the danger of erosion has passed, the Contractor shall remove all silt fence and sediment traps from the site, remove accumulated silt, and restore the area with structural fill, topsoil and seed as appropriate.

END OF SECTION 312500

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SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Standard Specifications for Highway and Bridge Construction, latest edition (State Specification)

C. Geotechnical Engineering Services Report for the Public Safety Building, Prairie du Chien, Wisconsin prepared by Professional Services Industries, Inc., dated May 7, 2024.

1.2 SUMMARY

A. Section Includes:
   1. Hot-mix asphalt paving.

B. Related Requirements: Retain subparagraphs below to cross-reference requirements Contractor might expect to find in this Section but are specified in other Sections.

   1. Section 312000 "Earth Moving" for subgrade preparation, fill material, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.

1.3 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

   1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:

      a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
      b. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Include technical data and tested physical and performance properties.
   2. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.

3. Job-Mix Designs: For each job mix proposed for the Work.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each paving material.

B. Material Test Reports: For each paving material, by a qualified testing agency.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Paving-mix manufacturer shall be registered with and approved by WisDOT.

B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Tack Coat: Minimum surface temperature of 60 deg F.
2. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
3. Asphalt Surface Course: Minimum surface temperature of 40 deg F at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Follow Section 305 of the State Specifications.

B. Coarse Aggregate: ASTM D 692/D 692M, sound; angular crushed stone, or crushed gravel.

C. Fine Aggregate: AASHTO M 29, sharp-edged natural sand or sand prepared from stone or gravel.

1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: Follow Section 455 of the State Specifications 3 LT 58-28 S as indicated on the plans,

B. Tack Coat: Follow Section 455.2.5. of the State Specifications, Type MS2

C. Asphalt Surface: Follow Section 455 of the State Specifications 4 LT 58-28 S as indicated on the plans,

2.3 AUXILIARY MATERIALS

A. Recycled Materials for Hot-Mix Asphalt Mixes: Section 460.2.5 of the State Specifications

2.4 MIXES

A. Recycled Content of Hot-Mix Asphalt: Follow Section 460.2.5 of the State Specifications.

B. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph.
2. Proof roll with a loaded 10-wheel, tandem-axle dump truck.
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Geotechnical Engineer, and replace with compacted backfill or fill as directed.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 gal./sq. yd.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.3 PLACING HOT-MIX ASPHALT

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
2. Place hot-mix asphalt surface course in single lift.
3. Spread mix at a minimum temperature of 275 deg F.
4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches from strip to strip to ensure proper compaction of mix along longitudinal joints.
2. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.4 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
3. Offset transverse joints, in successive courses, a minimum of 24 inches.
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method.
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.5 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density: Revise average density and range of acceptable densities in applicable "Average Density" Subparagraph below if required. First subparagraph refers to Marshall Test method. Revise to Superpave Gyratory Compactor test method to verify field compaction if using Superpave method of mix design. Second subparagraph refers to Rice test method preferred by AI.

1. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent or greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.6 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch
2. Surface Course: Plus 1/4 inch no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 5-foot straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch
2. Surface Course: 1/4 inch

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner may engage a qualified testing agency to perform tests and inspections.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to AASHTO T 168.

1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.

    a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than three cores taken.
    b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

E. Replace and compact hot-mix asphalt where core tests were taken.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

END OF SECTION 321216

SECTION 321300- RIGID PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Standard Specifications for Highway and Bridge Construction, latest edition (State Specification)

C. Geotechnical Engineering Services Report for the Public Safety Building, Prairie du Chien, Wisconsin prepared by Professional Services Industries, Inc., dated May 7, 2024.

1.2 SUMMARY

A. Section Includes Rigid Paving

1. Driveways.
2. Curbs.
3. Walks.
4. Slabs
5. Pavement

B. Related Requirements:
1. Section 312000 “Earth Moving."

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to concrete paving, including but not limited to, the following:

a. Concrete mixture design.
b. Quality control of concrete materials and concrete paving construction practices.

2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:

    a. Contractor's superintendent.
    b. Independent testing agency responsible for concrete design mixtures.
    c. Ready-mix concrete manufacturer.
    d. Concrete paving Subcontractor.

1.5 ACTION SUBMITTALS

A. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.6 INFORMATIONAL SUBMITTALS

A. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Fiber reinforcement.
4. Admixtures.
5. Curing compounds.
6. Applied finish materials.
7. Bonding agent or epoxy adhesive.
8. Joint fillers.

B. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

1.8 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

1. When air temperature has fallen to or is expected to fall below 40 deg F , uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

C. Hot-Weather Concrete Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. Concrete shall be Grade A, air entrained and shall conform to section 501 of the State Specifications, and in particular meet the following requirements:

1.	Minimum cement content - sacks per cubic yard	6.0
2.	Compressive strength after 28 days cured	4,000 psi
3.	Maximum amount of water per sack of cement	6.0 gallons
4.	Size of coarse aggregate required	No. 1 plus No. 2
5.	Slump	1 Inch - 3 Inches
6.	Air Content	5.0% - 7.0%
7.	No admixtures (flyash, etc.)	

2.2 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

A. Tie Bars: Section 505.2.6.3. of the State Specifications.

2.4 CURING MATERIALS

A. Curing membrane meeting the requirements for Type 2 of the "STANDARD SPECIFICATIONS FOR LIQUID MEMBRANE FORMING COMPOUNDS FOR CURING CONCRETE AASHTO DESIGNATION M148" shall be used to cover all finished concrete.

2.5 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that comply with or exceed requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared base course surface below concrete paving areas to identify soft pockets and areas of excess yielding.

1. Completely proof-roll base course in one direction
2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck.
3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/4 inch according to requirements in Section 312000 "Earth Moving" and the Geotechnical Report.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove loose material from compacted base course surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with Section 505.3 of the State Specifications.

3.5 JOINTS

A. General: Form construction, expansion, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

2. When paving against existing concrete, provide fiber expansion joints between the existing concrete and the new concrete.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Provide tie bars at sides of paving strips and where new curb ties into existing curb (drilled in).

C. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes Retain "Sawed Joints" Subparagraph below if saw cutting is permitted. Timing is critical for sawed joints. Widen top portion of sawed joint if joint sealants are required. Description below allows conventional wet- and dry-cut saws and if required depth of cut can be achieved, early-entry dry-cut saws.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/4-inch- wide joints into concrete to a depth of 2-1/2 inches when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

D. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes.

E. Joint Filler: Comply with section 415.2.6 of the State Specification and furnish a hot-poured elastic joint sealer according to ASTM D6690 type II.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Screed paving surface with a straightedge and strike off.

H. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

I. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.

J. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
   1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.

3.8 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

D. Curing Methods: Cure concrete by curing compound as follows:

   1. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.9 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

   1. Elevation: 3/4 inch.
   2. Thickness: Plus 3/8 inch, minus 1/4 inch.
   3. Surface: Gap below 10-feet- long; unleveled straightedge not to exceed 1/2 inch.
   4. Joint Spacing: 3 inches
   5. Contraction Joint Depth: Plus 1/4 inch, no minus.
   6. Joint Width: Plus 1/8 inch, no minus.

3.10 FIELD QUALITY CONTROL

   1. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.

2. Air Content: ASTM C 231/C 231M, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
3. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
4. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
5. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.

    a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

B. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

C. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

D. Concrete paving will be considered defective if it does not pass tests and inspections.

3.11 REPAIR AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321300

SECTION 323113 - CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Chain-link fences.
2. Swing gates.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for cast-in-place concrete.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:

a. Fence and gate posts, rails, and fittings.
b. Chain-link fabric, reinforcements, and attachments.
c. Gates and hardware.

B. Shop Drawings: For each type of fence and gate assembly.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include accessories, hardware, gate operation, and operational clearances.

C. Samples for Verification: For each type of component with factory-applied finish, prepared on Samples of size indicated below:

1. Polymer-Coated Components: In 6-inch (150-mm) lengths for components and on full-sized units for accessories.

D. Delegated-Design Submittal: For structural performance of chain-link fence and gate frameworks, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of chain-link fence, and gate.

B. Product Test Reports: For framework strength according to ASTM F1043, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For gate operators to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing fence grounding; member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure to comply with performance requirements.
b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
c. Faulty operation of gate operators and controls.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design chain-link fence and gate frameworks.

B. Structural Performance: Chain-link fence and gate frameworks shall withstand the design wind loads and stresses for fence height(s) and under exposure conditions indicated according to ASCE/SEI 7.

C. Lightning Protection System: Maximum resistance-to-ground value of 25 ohms at each grounding location along fence under normal dry conditions.

2.2 FENCE FRAMEWORK

A. Posts and Rails: ASTM F1043 for framework, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F1043 or ASTM F1083 based on the following:

1. Fence Height: 96 inches (2440 mm).

2. Heavy-Industrial-Strength Material: Group IA, round steel pipe, Schedule 40.

3. Horizontal Framework Members: top and bottom rails according to ASTM F1043.

4. Brace Rails: ASTM F1043.
5. Metallic Coating for Steel Framework:

a. Type A: Not less than minimum 2.0-oz./sq. ft. (0.61-kg/sq. m) average zinc coating according to ASTM A123/A123M or 4.0-oz./sq. ft. (1.22-kg/sq. m) zinc coating according to ASTM A653/A653M.
b. Type B: Zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. (0.27 kg/sq. m) of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film.
c. External, Type B: Zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. (0.27 kg/sq. m) of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film. Internal, Type D, consisting of 81 percent, not less than 0.3-mil- (0.0076-mm-) thick, zinc-pigmented coating.
d. Type C: Zn-5-Al-MM alloy, consisting of not less than 1.8-oz./sq. ft. (0.55-kg/sq. m) coating.
e. Coatings: Any coating above.

2.3 SWING GATES

A. General: ASTM F900 for gate posts and single swing gate types.

1. Gate Leaf Width: 36 inches (914 mm).

B. Pipe and Tubing:

1. Zinc-Coated Steel: ASTM F1043 and ASTM F1083; protective coating and finish to match fence framework.
2. Gate Posts: Round tubular steel.
3. Gate Frames and Bracing: Round tubular steel.

C. Frame Corner Construction: Welded or assembled with corner fittings.

D. Hardware:

1. Hinges: 180-degree outward swing.
2. Latch: Permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.
3. Lock: Manufacturer's standard internal device.

2.4 FITTINGS

A. Provide fittings according to ASTM F626.

B. Post Caps: Provide for each post.

1. Provide line post caps with loop to receive tension wire or top rail.

C. Rail and Brace Ends: For each gate, corner, pull, and end post.

D. Rail Fittings: Provide the following:

1. Top Rail Sleeves: Pressed-steel or round-steel tubing not less than 6 inches (152 mm) long.
2. Rail Clamps: Line and corner boulevard clamps for connecting bottom rails to posts.

E. Tension and Brace Bands: Pressed steel.

F. Tension Bars: Steel, length not less than 2 inches (50 mm) shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.

G. Tie Wires, Clips, and Fasteners: According to ASTM F626.

1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, according to the following:

a. Hot-Dip Galvanized Steel: 0.106-inch- (2.69-mm-) diameter wire; galvanized coating thickness matching coating thickness of chain-link fence fabric.

H. Finish:

1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz./sq. ft. (366 g/sq. m) of zinc.

2.5 GROUT AND ANCHORING CEMENT

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout, recommended in writing by manufacturer, for exterior applications.

B. Anchoring Cement: Factory-packaged, 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 needing protection by a sealer or waterproof coating, and that is recommended in writing by manufacturer for exterior applications.

2.6 GROUNDING MATERIALS

A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Connectors and Grounding Rods: Listed and labeled for complying with UL 467.

1. Connectors for Below-Grade Use: Exothermic welded type.
2. Grounding Rods: Copper-clad steel, 5/8 by 96 inches (16 by 2440 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.

1. Do not begin installation before final grading is completed unless otherwise permitted by Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet (152 m) or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 CHAIN-LINK FENCE INSTALLATION

A. Install chain-link fencing according to ASTM F567 and more stringent requirements specified.

B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.

C. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.

1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.

    a. Exposed Concrete: Extend 2 inches (50 mm) above grade; shape and smooth to shed water.
    b. Posts Set into Holes in Concrete: Form or core drill holes not less than 5 inches (127 mm) deep and 3/4 inch (20 mm) larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed according to anchoring material manufacturer's written instructions. Finish anchorage joint to slope away from post to drain water.

D. Terminal Posts: Install terminal end, corner, and gate posts according to ASTM F567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more. For runs exceeding 500 feet (152 m), space pull posts an equal distance between corner or end posts.

E. Line Posts: Space line posts uniformly at 10 feet (3 m) o.c.

F. Post Bracing and Intermediate Rails: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.

1. Locate horizontal braces at midheight of fabric 72 inches (1830 mm) or higher, on fences with top rail, and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.

G. Top Rail: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.

H. Intermediate and Bottom Rails: Secure to posts with fittings.

I. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts, with tension bands spaced not more than 15 inches (380 mm) o.c.

J. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric according to ASTM F626. Bend ends of wire to minimize hazard to individuals and clothing.

1. Maximum Spacing: Tie fabric to line posts at 12 inches (300 mm) o.c. and to braces at 24 inches (610 mm) o.c.

K. Fasteners: Install nuts for tension bands and carriage bolts on the side of fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

3.4 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation.

3.5 GROUNDING AND BONDING

A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Fence and Gate Grounding:

1. Ground for fence and fence posts shall be a separate system from ground for gate and gate posts.
2. Fences within 100 Feet (30 m) of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 feet (225 m).
3. Ground fence on each side of gates and other fence openings.

    a. Bond metal gates to gate posts.
    b. Bond across openings, with and without gates, except openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches (457 mm) below finished grade.

C. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches (152 mm) below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.

D. Connections:

1. Make connections with clean, bare metal at points of contact.
2. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
3. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
4. Make above-grade ground connections with mechanical fasteners.
5. Make below-grade ground connections with exothermic welds.
6. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

E. Bonding to Lightning Protection System: Ground fence and bond fence grounding conductor to lightning protection down conductor or lightning protection grounding conductor according to NFPA 780.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests.

3.7 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Lubricate hardware and other moving parts.

END OF SECTION 323113

SECTION 323500 - SITE SCREENING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pre-Formed Panels: For screening or buffering trash enclosures.

1. Powder coated metal.

B. Aluminum Support Framing: For direct attachment of screen support columns to/into concrete pads, piers, or footings provided by others.

C. Operable gates for access through screens.

D. Not Included in This Specification:

1. Touch-up painting required for scratches and screw heads.
2. Field painting of prime painted screens

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM B 221 - Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire Profiles, and Tubes.

B. The Aluminum Association, Inc. (AA):

1. AA ADM-1516166 - Aluminum Design Manual

C. American Society of Civil Engineers (ASCE):

1. ASCE 7-18 - Minimum Design Loads for Buildings and Other Structures.

1.3 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data:

1. Manufacturer's data sheets on each product to be used.
2. Preparation instructions and recommendations.
3. Storage and handling requirements and recommendations.
4. Typical installation methods.
5. Sufficient data and detail to indicate compliance with these specifications.

C. Verification Samples: Two representative units of each panel type.

1. Color Selection: Submit paint chart with full range of colors available for Architect's selection. Custom color samples available upon purchase

D. Shop Drawings: Indicate layout heights, component connection details, and details of interface with adjacent construction.

E. Certification: Manufacturer's Certificate of Compliance certifying that panels supplied meet or exceed requirements specified.

F. Closeout Submittals: Warranty documents, issued and executed by manufacturer, countersigned by Contractor.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with a minimum one years documented experience.

B. Installer Qualifications: Company specializing in performing Work of this section with minimum two years documented experience with projects of similar scope and complexity.

C. Source Limitations: Provide each type of product from a single manufacturing source to ensure uniformity.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

B. Storage and Handling: Protect materials and finishes during handling and installation to prevent damage.

C. Protect from damage due to weather, excessive temperature, and construction operations.

1.6 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.

B. Field Measurements: Take measurements of supporting paving, footings, or piers. Indicate measurements on shop drawings fully documenting any field condition that may interfere with the screen system installation.

1.7 COORDINATION

A. Installer for work under this Section shall be responsible for coordination of panel and framing sizes and required options with the Contractor's requirements.

1. Request information on sizes and options required from the Contractor.

B. Submit shop drawings to the Contractor and obtain written approval of shop drawing from the Contractor prior to fabrication.

C. Confirm size, type, and location of supporting construction as adequate to resist column supports.

1.8 WARRANTY

A. If any part of the screen system fails because of a manufacturing defect within 1 to 5 years from the date of substantial completion, the manufacturer will furnish the required replacement parts without charge. Any local transportation, related service labor, or diagnostic call charges are not included.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: CityScapes International Inc., which is located at: 4200 Lyman Ct., Hilliard, OH 43026; Toll Free: 877-SCREENS; Phone: 614-850-2549; Email: contact@cityscapesinc.com; Web: https://cityscapesinc.com/

1. Basis of Design: Covrit Gates and Screening System by CityScapes International Inc.

B. Requests for substitutions will be considered in accordance with provisions of Section 002600.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. Regulatory Requirements: Comply with requirements of building authorities having jurisdiction in Project location.

B. Design Criteria: Manufacturer is responsible for the structural design of all materials, assembly, and attachments to resist snow, wind, suction and uplift loading at any point without damage or permanent set.

1. Framing: Designed in accordance with the Aluminum Design Manual to resist the following loading:

a. ASCE 7-18 - Minimum Design Loads for Buildings and Other Structures; American Society of Civil Engineers.

2.3 MATERIALS

A. Paneling: Minimum Thickness: 0.050”

1. Aluminum Extruded Shapes: Powder coated.

B. Operable Access Gates: Minimum Panel thickness: 0.050”

1. ToughGate: Powder coated extruded Aluminum shapes.

C. Framing: Aluminum Plate, Shapes and Bar: ASTM B221, alloy 6005-T5, 6061-T5 or 6063-T5.

D. Threaded Fasteners: Screws, bolts, nut and washers to be Stainless Steel.

1. Post Backer assembly fasteners shall be #10-16 stainless steel Self-Drilling screws.
2. Provide lock washer or other locking device at all bolted connections.

2.4 FABRICATION

A. Factory-Formed Panel Systems: Continuous interlocking panel connections and indicated or necessary components.

1. Form components true to shape, accurate in size, square and free from distortion or defects. Cut panels to precise lengths indicated on approved shop drawings.

B. Fabricate products to the following configurations:

1. Panel Style: Planar Formed Aluminum Panel.
2. ToughGate Gate Style: Planar Formed aluminum panel.
3. Panel Height: 6 ft (1829 mm).
4. Panel and Gate Height: 6 ft (1829 mm).
5. Gate Width: 63 inches (1600 mm).
6. Column Cap Style: Pyramid cap aluminum.
7. Dumpster Layout: 11 x 11 ft (3353 x 3353 mm).
8. Trim and Closures: Fabricated and finished with Manufacturer's standard coating system, unless shown otherwise on drawings.

C. Framing: Fabricate and assemble components in largest practical sizes, for delivery to the site.

1. Construct corner assemblies to required shape with joints tightly fitted.
2. Supply components required for anchorage of framing. Fabricate anchors and related components of material and finish as required, or as specifically noted.

D. Gate Hardware: Provide manufacturer's adjustable standard of size required to fit support pipe provided.

1. Hinge Type: Hold open.

2.5 FINISHES

A. Aluminum Framing: Mill finish.

B. Panel Coating: Manufacturer's standard powder coating system, factory applied.

1. Color: Selected from full range of manufacturer's standard colors.

PART 3 EXECUTION

3.1 EXAMINATION

A. Installer's Examination: Examine conditions under which construction activities of this section are to be performed.

1. Submit written notification to Architect and Screen manufacturer if such conditions are unacceptable.
2. Beginning erection constitutes installer's acceptance of conditions.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install units in accordance with the manufacturer's instructions and approved shop drawings. Keep perimeter lines straight, plumb, and level. Provide brackets, anchors, and accessories necessary for complete installation.

B. Fasten structural supports to/into paving, footings, or piers at spacing as indicated on approved shop drawings.

C. Metal Separation: Where aluminum materials would contact dissimilar materials, insert rubber grommets at attachment points, thus eliminating where dissimilar metals would otherwise be in contact.

D. Do not cut or abrade finishes which cannot be restored. Return items with such finishes to shop for required alterations.

3.4 ERECTION TOLERANCES

A. Maximum misalignment from true position: 1/4 inch (6 mm).

3.5 CLEANING AND PROTECTION

A. Remove all protective masking from material immediately after installation.

B. Protection:

1. Ensure that finishes and structure of installed systems are not damaged by subsequent construction activities.
2. If minor damage to finishes occurs, repair damage in accordance with manufacturer's recommendations; provide replacement components if repaired finishes are unacceptable to Architect.

C. Prior to Substantial Completion: Remove dust or other foreign matter from component surfaces; clean finishes in accordance with manufacturer's instructions.

1. Clean units in accordance with the manufacturer's instructions.

END OF SECTION 323500

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SECTION 329200 -TURF AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Standard Specifications for Highway and Bridge Construction, latest edition (State Specification)

C. Section 311000 “Site Clearing.”

D. Section 312000 “Earth Moving.”

E. Section 312500 “Erosion and Sediment Control.”

1.2 SUMMARY

A. Section Includes:

1. Seeding.
2. Erosion Matting

1.3 INFORMATIONAL SUBMITTALS

A. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

B. Product Certificates: For fertilizers, from manufacturer.

C. Erosion Matting: Product label and manufacturer's application instructions.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

1.5 FIELD CONDITIONS

A. Planting Restrictions: Full Growing Season: April 15 through November 15.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 SEED

A. Grass Seed: Follow section 630.2.1.5.1 of the State Specifications: Mixture No. 40

2.2 FERTILIZERS

A. Fertilizer: Granular or liquid with content analysis

B. 1-2-1 nitrogen-phosphorus-potassium ratio; at least 50% nitrogen content in organic, slow release form.

2.3 EROSION MAT

A. Meet WDNR Technical Standard 1052, Class 1, Type A, for non-channel erosion mat on slopes 2:1 or flatter.

B. Meet WDNR Technical Standard 1053, Class 1, Type A, for non-channel erosion mat in channels and ditches.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
3. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect adjacent and adjoining areas from hydroseeding and hydro-mulching overspray.
2. Protect grade stakes set by others until directed to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION

A. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

B. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 PREPARATION FOR EROSION-CONTROL MATERIALS

A. Follow WDNR Technical Standard 1052.

3.5 SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph.

1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
2. Do not use wet seed or seed that is moldy or otherwise damaged.
3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

B. Sow seed at a total rate of 2 lb/1000 sq. ft.

C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.

D. Protect seeded areas with erosion-control mats where indicated on Drawings; install and anchor according to manufacturer's written instructions.

3.6 TURF MAINTENANCE

A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.

C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height: 3-inches

3.7 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Architect:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 1 foot by 1 foot.

B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

3.8 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

D. Remove nondegradable erosion-control measures after grass establishment period.

END OF SECTION 32 92 00

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SECTION 334200 - STORMWATER CONVEYANCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Standard Specifications for Sewer and Water Construction in Wisconsin (Standard Specifications)

C. Standard Specifications for Highway and Bridge Construction, latest edition (State Specification)

D. Section 312000 “Earth Moving.”

E. Section 311000 “Site Clearing.”

F. Geotechnical Engineering Services Report for the Public Safety Building, Prairie du Chien, Wisconsin prepared by Professional Services Industries, Inc., dated May 7, 2024.

1.2 SUMMARY

A. Section Includes:

1. Pipe and fittings.
2. Manholes.
3. Catch basins.
4. Inlets

1.3 ACTION SUBMITTALS

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

B. Shop Drawings:

1. Manholes: Include plans, elevations, sections, details, frames, and covers.
2. Catch basins, inlets: Include plans, elevations, sections, details, frames, covers, and grates.
3. Underground Stormwater Management Systems: Include plans, elevations, details, specifications for oversized storm sewer and connections, underground storage facility.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of pipe and underground stormwater management system from manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect pipe, pipe fittings, and seals from dirt and damage.

B. Handle manholes according to manufacturer's written rigging instructions.

C. Handle catch basins and stormwater inlets according to manufacturer's written rigging instructions.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76, Class III/IV with concrete end walls where shown on plans.

1. Bell-and-spigot ends and gasketed joints with ASTM C 443 rubber gaskets
2. Class as shown on the Contract Drawings

B. PVC: ASTM 3034, SDR 35 or ASTM 794 Ultra-Rib with integral bell and rubber gasket joints

C. HDPE (dual wall): ASTM F2306, AASHTO M-252 (4 to 10-inch diameter), AASHTO M-294 (12 to 60-inch diameter), bell and spigot joint, ASTM F477 gaskets.

D. Corrugated Metal Pipe and Fittings: ASTM A760, AASHTO M-36.

2.2 MANHOLES

A. Standard Precast Concrete Manholes: follow 8.39.0 of the Standard Specifications

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: As shown on the Contract Drawings.
3. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
4. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
5. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
6. Joint Sealant: ASTM C 990 bitumen or butyl rubber.
7. Resilient Pipe Connectors: Follow 8.41.0 of the Standard Specifications.
8. Steps: Steel Reinforced Plastic meeting 8.40.0 of the Standard Specifications.
9. Grade Rings: Reinforced-concrete rings, follow 8.39.11 of the Standard Specifications.

B. Manhole Frames and Covers:

1. Meet requirements of 8.48.0 of the Standard Specifications. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."

2.3 CATCH BASINS or INLETS

A. Standard Precast Concrete Catch Basins or Inlets: as required on plans

B. Nyloplast Drain Basin: as required on plans

C. Castings: Castings for catch basins shall be as required on plans.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

B. Geotechnical Report should be followed to determine acceptable trench backfill.

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate location and arrangement of underground storm drainage piping. Follow 3.2.0 of the Standard Specifications.

3.3 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.
1. Install manholes in accordance with Section 611 of the State Specifications, unless otherwise noted herein.

B. Install precast concrete manhole sections with joints in accordance with 8.39.5.

C. Where specific manhole construction is not indicated, follow manhole manufacturer's written instructions.

3.4 CATCH BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated on Contract Drawings.

B. Install manholes in accordance with Section 611 of the State Specifications, unless otherwise noted herein.

C. Set frames and grates to elevations indicated. Concrete adjusting rings shall not be less than 2" thick. Adjustment less than 2" thick shall be made with composite rubber adjustment rings. The least number of rings possible shall be used.

3.5 CLEANING

A. Clean interior of piping of dirt and superfluous materials.

END OF SECTION 334200



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