



This addendum forms a part of the Contract Documents and modifies the original Documents dated **February 2, 2026**, as noted below. Acknowledge receipt of this addendum in the space provided on the Official Bid Form. Failure to do so may subject the Bidder to disqualification.

**REVISION TO 00 0110 – TABLE OF CONTENTS**

Disregard **original** – 00 0110 – TABLE OF CONTENTS and replace with the **ENCLOSED 00 0110 - TABLE OF CONTENTS**, *in its entirety*.

**ENCLOSED 02 0001 – HAZARDOUS MATERIALS REPORT**

*Enclosed 02 0001 – HAZARDOUS MATERIALS REPORT, in its entirety.*

**REVISION TO 08 7100 – DOOR HARDWARE**

Disregard **original** – 08 7100 – DOOR HARDWARE and replace with the **ENCLOSED 08 7100 – DOOR HARDWARE**, *in its entirety*.

**REVISION TO 10 2113.19 – PLASTIC TOILET COMPARTMENTS**

Disregard **original** – 10 2113.29 – PLASTIC TOILET COMPARTMENTS and replace with the **ENCLOSED 10 2113.19 – PLASTIC TOILET COMPARTMENTS**, *in its entirety*.

**REVISION TO 10 2800 – TOILET, BATH, AND LAUNDRY ACCESSORIES**

Disregard **original** – 10 2800 – TOILET, BATH, AND LAUNDRY ACCESSORIES and replace with the **ENCLOSED 10 2800 – TOILET, BATH, AND LAUNDRY ACCESSORIES**, *in its entirety*.

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- 26 2726 – WIRING DEVICES
- 26 5100 – LED LIGHTING

**SUBSTITUTION REQUESTS**

**APPROVED**

1. Section: Plastic Toilet Compartments 102113.19  
Product: Scranton, Hiny Hiders  
Paragraph: 2.02 Solid Plastic Partitions

Proposed Substitution

Manufacturer: ASI Group; ASI Global Partitions & ASI Accurate Partitions  
Description: Solid Plastic Partitions

2. Section: Plastic Toilet Compartments 102113.19  
Product: Solid Plastic (HDPE) – Scranton-Aria  
Paragraph: Solid Plastic Toilet Compartments (HEPE) – Doors, Panels, Pilasters, 1" Thick  
Stainless-Steel Hardware

Proposed Substitution

Manufacturer: Accutec MFG. Solid (HOPE)  
Description: Solid (HDPE) floor mount overhead braced with stainless steel hardware

## **REVISION TO DRAWINGS**

*Replace the following with enclosed revised sheets*

### **G0.00 – COVER SHEET**

1. Updated index of drawings.

### **AD2.00 – DEMOLITION FLOOR PLAN**

1. Existing carpet is indicated as to be removed from Room 143. Description of demolition plan legend note for floor finish removal has been revised to “DEMOLISH EXISTING FLOOR CARPET FINISH AND WALL BASE IN THEIR ENTIRETY. PREPARE FLOOR SURFACE FOR NEW FINISH.”

### **AD3.00 – DEMOLITION REFLECTED CEILING PLAN**

1. Revised sheet note # 16 to #18. Description has been revised to “REPAIR, ADJUST, AND PREPARE CEILING GRID FOR REVISED LIGHTING AND ACOUSTIC PANELS”.

### **A2.00 – OVERALL FLOOR PLAN**

1. Room 143 is now indicated to receive polished concrete floor finish.

### **A8.01 – DOOR HARDWARE AND RESTROOM EQUIPMENT SCHEDULE**

1. Schedule previously titled, “EQUIPMENT SCHEDULE” is now correctly titled “RESTROOM PARTITION AND ACCESSORY SCHEDULE”.

## **QUESTIONS AND CLARIFICATIONS**

**Question:** At the existing floor transitions from restroom tile floors to corridor polished concrete floors, there is an existing metal transition strip. How is this transition to be handled in the project? Is the transition to be completely level?

**Answer:** **Per the demolition and new floor plans on each restroom sheet, A2.10, A2.11, and A2.12, the existing transition locations will be moved out to the hallway walls. The new transition is to be constructed per Detail B2/A9.70. Structural concrete slab demolition and infill plans will be revised to match architectural in Addendum #2.**

**Question:** Are existing floor drain heights to be adjusted to flush out with new tile floor finish?

**Answer:** **If new concrete slabs or thickness of the new tile assembly require adjusting the heights of the existing floor drains so they flush out with the new tile floor finish, that will be required of the contractor.**

**Question:** On Sheet AD2.00 Demolition Floor Plan, the crosshatch diagram in the legend states “Demolish Existing Flooring...” What is the flooring to demolish? Just the finish? Type of Flooring?

**Answer:** **All locations indicated by this hatch pattern are currently covered by carpet. The intention is to remove the carpet at the indicated location and prepare the existing concrete floor slab for a polished concrete finish. The note will be revised to say “Demolish Existing Floor Carpet Finish...”**

**Question:** How will fluorescent lamp disposal be handled?

**Answer:** **See Specification Section 26 05 05, 3.05, I.**

Question: The existing generator was originally to be replaced. Has this work been removed from the project?

Answer: **Yes, replacement of the existing generator has been removed from the project.**

Question: Is asbestos abatement expected?

Answer: **No, asbestos abatement is not expected as part of this project. Review the Limited Asbestos Survey in Specification Section 00 01 15.**

Question: Will a door hardware group schedule be provided?

Answer: **Yes, the door hardware group schedule has been added to the end of specification section 08 71 00.**

Question: Do you have an engineer's estimate for this project? We need that to order our bid bond. I have no idea what the light fixture replacement cost will be.

Answer: **We do not have a formal engineer's estimate for this project. Bidders are expected to determine their own pricing based on the bid documents and site conditions.**

#### **PRE-BID MEETING SIGN IN SHEET**

Please review the attached sign in sheet; if corrections are required, please send them to Anita DeBoard, Project Administrator, [anita.deboard@hmkco.org](mailto:anita.deboard@hmkco.org).

**END OF ADDENDUM 1**





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**ATTACHMENT A** – Prevailing Wage Rate – January 5, 2026

SECTION 02 00 01 – HAZARDOUS MATERIAL REPORT

See attached Limited Asbestos Survey from G2 Consultants dated August 25, 2005 on the following pages.



# Limited Asbestos Survey

Purpose: Pre-Renovation

Client:

**Redmond School District  
145 SE Salmon Drive  
Redmond, Oregon 97756**

Project:

**Obsidian Middle School  
1335 Southwest Obsidian Avenue  
Redmond, Oregon 97756**

G2 Project #: G25-230

August 25, 2025

Prepared By:

G2 Consultants  
7312 SW Durham Road  
Portland, Oregon 97224  
888-998-4224  
[www.g2ci.com](http://www.g2ci.com)  
CCB#: 253530

# Limited Asbestos Survey

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G2 Consultants Project #: G25-230

**Purpose of Inspection:** Pre-Renovation

**Scope of Inspection:** Limited Asbestos Survey

**Project Description:** Obsidian Middle School Modernization Project

**Project Address:** 1335 Southwest Obsidian Avenue  
Redmond, Oregon 97756

**Owner or Facility Operator:** Redmond School District  
145 SE Salmon Drive  
Redmond, Oregon 97756

**Owner or Facility Operator Phone #:** 503-508-7522

## Technical Certifications

Consultant	Discipline	Certification #	Regulatory Agency	Phone Number
Dan Rouse	Asbestos Building Inspector	IRO-24-5295A	EPA	503-701-7325
Drew Rouse	Asbestos Building Inspector	IN-24-4444C	EPA	971-464-8756



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## Executive Summary

G2 Consultants (G2) was retained by Redmond School District (RSD) to limited asbestos survey. The survey consisted of a building inspection for asbestos-containing materials (ACM) in the areas outlined in the provided scope of work documented dated August 8, 2025. The survey was conducted at Obsidian Middle School (OMS), located at 1335 Southwest Obsidian Avenue, in Redmond, Oregon. The scope of the inspection was limited to only the areas outlined in the provided scope of work document, as specified by RSD. Authorization was provided by Erin, Donoghue, Project Manager with HMK Company, the representative for RSD.

**Date of Inspection:** August 13, 2025

**Purpose of Inspection:** Pre-Renovation

**Scope of Inspection:** Limited to the areas as outlined in the HMK provided scope of work document dated August 8, 2025. However, no destructive investigation activities were performed to assess for potentially concealed materials.

### Asbestos

Previous survey data, and sample results from this survey, have determined that materials listed in the following table are ACMs, containing asbestos in an amount greater than 1%:

Asbestos-Containing Materials Identified or Presumed - Overview				
Material Description	Material Location	Approx. Quantity	Condition	Friable Y/N
Sink Undercoating, White	Library, Art Labs, and Band Room	4 Sinks	Good	Y

NOTE: Friability listed is based on conditions at the time of G2's survey. Materials may become friable if disturbed.

Details of the inspection, descriptions and locations of materials, quantities, condition and friability can be found in the following sections of this report.

## Description of Structure(s)

Type of facility:	Middle School
Past uses:	Middle School
Age of construction:	Original School Construction - 1980 Office and Tech Addition - 2023
Approximate square footage:	106,239 sq. ft.
Number of floors:	One with Interior Mezzanines
Outbuildings included in inspection:	None
Inaccessible rooms/areas:	None



## Scope of Inspection

G2 was contracted by RSD to perform a limited asbestos survey for ACMs within the school. The survey was conducted at the OMS, located at 1335 Southwest Obsidian Avenue, in Redmond, Oregon. The scope of the survey included all materials within the HMK provided scope of work document dated August 8, 2025, as specified by Erin Donoghue with HMK Company. The sampling was conducted to represent all suspect materials within the scope of work.

## Asbestos

The scope of services was to perform a visual and tactile inspection, and identify the presence, quantity and location of the accessible ACM, within the area(s) of the scope of work. All identified accessible suspect materials were sampled. The building was occupied at the time of the survey, therefore, destructive sampling techniques were not utilized to gain access to potentially hidden materials.

Other suspect ACMs may be present in the building that were not accessible at the time of the survey. Furthermore, the material locations and quantities provided in this report represents the accessible areas within the buildings only. ACMs identified during this survey, if hidden or concealed, may potentially be located in additional areas of the property, and at greater quantities than those stated in this report.

## Inspection Findings

### Asbestos

Previous survey data, and sample results from this survey, have determined that materials listed in the following table are ACMs, containing asbestos in an amount greater than 1%:

Asbestos-Containing Materials Identified or Presumed							
HM No.†	Material Description	Material Location	Approx. Quantity	No. of Samples	Asb. Type & %	Condition	Friable Y/N
13	Sink Undercoating, White	Library, Art Labs, and Band Room	4 Sinks	2	Chrysotile 7%*	Good	Y

NOTE: Friability listed is based on conditions at the time of G2's survey. Materials may become friable if disturbed.

† - Homogeneous material number

\*- Based on Previous Data Collected

Previous survey data, and sample results of this survey have determined that materials listed in the following table do not contain asbestos in an amount greater than 1%:

Non Asbestos-Containing Materials Identified				
HM No.†	Material Description	Material Location*	Asb. Type & %	No. of Samples
1	Carpet Adhesive, Tan (Under Grey Carpet)	Band Room	ND	2
2	Cove Base, 4" Black, and Tan Adhesive	Band Room	ND*	2
3	Cove Base, 4" Brown, and Tan Adhesive	Band Room	ND*	2
4	Carpet Adhesive, Tan (Under Orange Carpet)	Band Room and Library	ND	2
5	Cove Base, 4" Grey, and Tan Adhesive	Classroom 142	ND	2
6	Ceramic Tile Grout (Wall)	Classroom 142 Restroom	ND	2

Non Asbestos-Containing Materials Identified				
HM No.†	Material Description	Material Location*	Asb. Type & %	No. of Samples
7	Ceramic Tile Grout (Floor)	Classroom 142 Restroom	ND	2
8	Ceiling Tile, 2' x 4' Fissured with Pinholes	Classroom 143 and Library	ND	2
9	Floor Tile, 1' x 2' Tan Stone Patterns, and Clear Adhesive	Restrooms Near Library	ND	2
10	Cove Base, 6" Brown, and Tan Adhesive	Restrooms Near Library	ND	2
11	Drywall & Joint Compound	Classroom 142	ND	2
12	Plaster Walls on Drywall Lathe	Library	ND	3

† - Homogeneous Material Number  
 ND - No Asbestos Detected  
 \*- Based on Previous Data Collected

Details of the samples collected, including locations of individual samples can be found in Appendix C: Laboratory Analysis Results & Chain of Custody.

## Recommended Response Actions

### Asbestos

#### Asbestos-Containing Materials (ACM)

Any building material which contains asbestos in an amount greater than 1% is considered an ACM by the United States Environmental Protection Agency (EPA) and Occupational Safety and Health Administration (OSHA), and by the State of Oregon Department of Environmental Quality (DEQ) and the Oregon Occupational Safety and Health Division (OR-OSHA).

The white sink undercoating in the library and art labs was determined to be an ACM.

#### Asbestos-Containing Materials - 1% Asbestos or Less

Any building material which contains asbestos in an amount of 1% or less is considered asbestos-containing by OSHA and OR-OSHA. Although these materials are not considered ACMs, workers must be protected from exposure to asbestos, regardless of the percentage.

No materials were identified during this survey that contained 1% or less asbestos.

Many of the engineering controls and work practices required by the EPA and OSHA are applicable only to materials that contain greater than 1% asbestos. However, OSHA has established work practice requirements and prohibitions that apply when asbestos is present in any quantity, and/or whenever worker exposure exceeds the PEL, regardless of the amount of asbestos in the materials involved. Applicable requirements for materials that contain 1% or less asbestos can be found in the OSHA Asbestos Construction Standard 29 CFR 1926.1101.

## Methodology

### Asbestos

The field work was conducted using industry best practices. Samples of representative accessible suspect materials within the scope of work were collected during the course of the inspection. Materials were sampled according to homogeneous groupings using the [Asbestos Hazard Emergency Response Act \(AHERA\)](#) sampling guidelines.

Asbestos samples were collected in such a manner as to minimize release of the material into the surroundings. Sample number, material description, sample location and material location were recorded at the time of sampling. Each sample was placed in a sample container labeled with a unique sample number and submitted to a National Voluntary Laboratory Accreditation Program (NVLAP) accredited laboratory, for analysis under chain of custody documentation. Samples were analyzed in accordance with EPA Method 600/R-93-116, using PLM with dispersion staining and using visual area estimation to determine percent asbestos content. This method allows for the identification of the primary types of asbestos used in building materials. The lower limit of detection for this method is one percent. Samples containing one percent or less asbestos by PLM with visual area estimation are reported as "Trace".

## Limitations

G2 has performed this inspection in accordance with best industry methods and practices of the profession, and consistent with the level of care and skill ordinarily exercised by reputable environmental consultants under similar circumstances and conditions. The observations contained within this assessment are based upon site conditions readily accessible at the time of the site inspection. No other representation, guarantee or warranty, express or implied, is included or intended in this hazardous materials survey report.

As with all environmental investigations, this inspection is limited to the defined scope and does not purport to set forth all hazards, nor indicate that other hazards do not exist.

Respectfully submitted and reviewed by:



Drew Rouse  
Project Manager  
G2 Consultants



Dan Rouse  
President  
G2 Consultants

# Appendix A:

## Photographs of Homogeneous Materials





HM#1: Carpet Adhesive, Tan (Under Grey Carpet)



HM#2: Cove Base, 4" Black, and Tan Adhesive



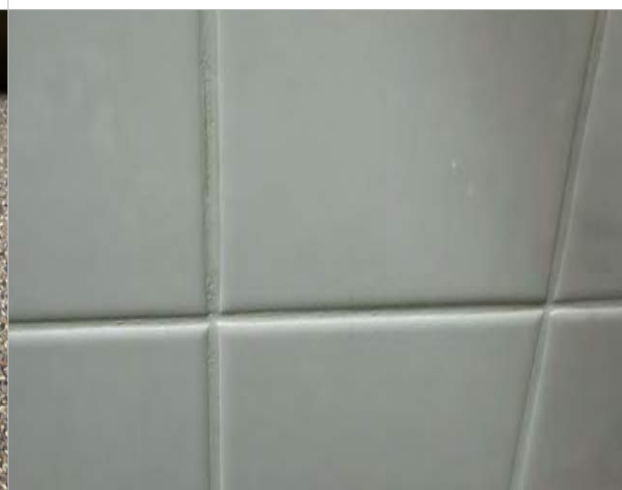
HM#3: Cove Base, 4" Brown, and Tan Adhesive



HM#4: Carpet Adhesive, Tan (Under Orange Carpet)



HM#5: Cove Base, 4" Grey, and Tan Adhesive



HM#6: Ceramic Tile Grout (Wall)



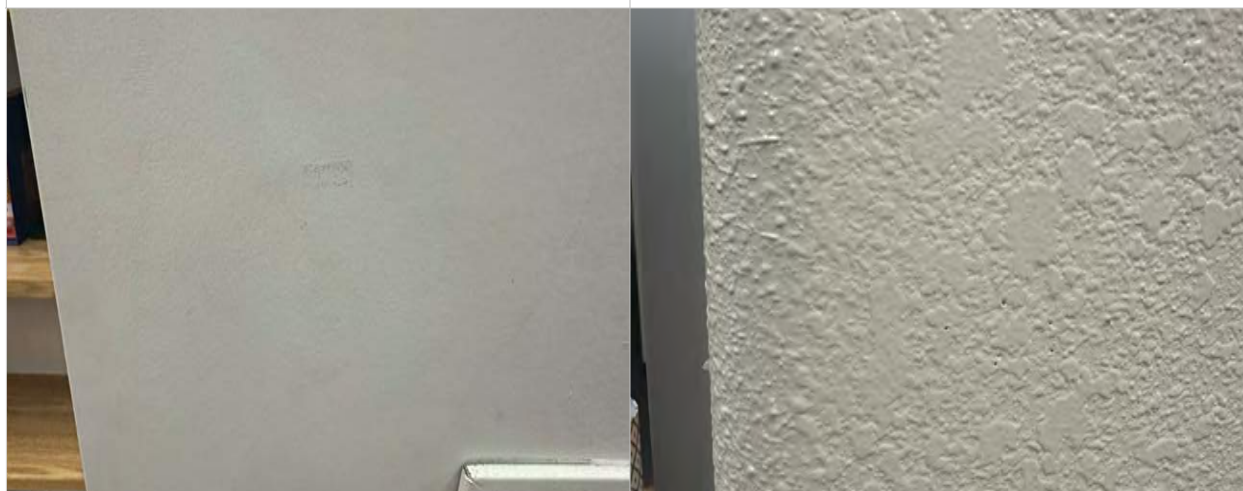
HM#7: Ceramic Tile Grout (Floor)

HM#8: Ceiling Tile, 2' x 4' Fissured with Pinholes



HM#9: Floor Tile, 1' x 2' Tan Stone Patterns, and Clear Adhesive

HM#10: Cove Base, 6" Brown, and Tan Adhesive



HM#11: Drywall & Joint Compound

HM#12: Plaster Walls on Drywall Lathe





HM#13: Sink Undercoating, White

# Appendix B:

## Laboratory Analysis Results & Chain of Custody

Report for:

**Drew Rouse**  
**G2 Consultants**  
17750 SW Upper Boones Ferry Rd  
Suite 150  
Portland, OR 97224

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Regarding: Eurofins Built Environment Testing West, LLC  
Project: G25-230; Redmond School District 1335 SW Obsidian Ave Redmond, OR  
EML ID: 4188598

Approved by:

Dates of Analysis:  
Asbestos PLM: 08-20-2025



Technical Manager  
Ryan Talaski-Brown

Service SOPs: Asbestos PLM (EPA 40CFR App E to Sub E of Part 763 & EPA METHOD 600/R-93-116, SOP EB-AS-S-1267)  
NVLAP Lab Code 200741-0

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All samples were received in acceptable condition unless noted in the Report Comments portion in the body of the report. The results relate only to the samples as received and tested. The results include an inherent uncertainty of measurement associated with estimating percentages by polarized light microscopy. Measurement uncertainty data for sample results with >1% asbestos concentration can be provided when requested.

Eurofins Built Environment Testing West, LLC ("the Company"), a member of the Eurofins Built Environment Testing group of companies, shall have no liability to the client or the client's customer with respect to decisions or recommendations made, actions taken or courses of conduct implemented by either the client or the client's customer as a result of or based upon the Test Results. In no event shall the Company be liable to the client with respect to the Test Results except for the Company's own willful misconduct or gross negligence nor shall the Company be liable for incidental or consequential damages or lost profits or revenues to the fullest extent such liability may be disclaimed by law, even if the Company has been advised of the possibility of such damages, lost profits or lost revenues. In no event shall the Company's liability with respect to the Test Results exceed the amount paid to the Company by the client therefor.

Client: G2 Consultants  
C/O: Drew Rouse  
Re: G25-230; Redmond School District 1335 SW  
Obsidian Ave Redmond, OR

Date of Sampling: 08-13-2025  
Date of Receipt: 08-15-2025  
Date of Report: 08-20-2025

## ASBESTOS PLM REPORT

**Total Samples Submitted:** 24

**Total Samples Analyzed:** 24

**Total Samples with Layer Asbestos Content > 1%:** 0

### Location: G25-230-1, Carpet Adh., Tan (Grey Carpet)

Lab ID-Version‡: 20937400-1

Sample Layers	Asbestos Content
Tan Mastic	ND
Sample Composite Homogeneity: Good	

### Location: G25-230-2, Carpet Adh., Tan (Grey Carpet)

Lab ID-Version‡: 20937401-1

Sample Layers	Asbestos Content
Tan Mastic	ND
Sample Composite Homogeneity: Good	

### Location: G25-230-3, CB, 4" Black + Tan Adh

Lab ID-Version‡: 20937402-1

Sample Layers	Asbestos Content
Black Cove Base	ND
Tan Mastic	ND
Sample Composite Homogeneity: Good	

### Location: G25-230-4, CB, 4" Brown+ Tan Adh

Lab ID-Version‡: 20937403-1

Sample Layers	Asbestos Content
Brown Cove Base	ND
Tan Mastic	ND
Sample Composite Homogeneity: Good	

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All components not quantified as asbestos content and non-asbestos content are considered to be non-fibrous matrix components. Matrix components may include, but are not limited to, gypsum, paint, silicate minerals, vinyl, binder, calcium carbonate, tar, and foam.

Inhomogeneous samples are separated into homogeneous subsamples and analyzed individually. ND means no fibers were detected. When detected, the minimum detection and reporting limit is less than 1% unless point counting is performed. Floor tile samples may contain large amounts of interference material and it is recommended that the sample be analyzed by gravimetric point count analysis to lower the detection limit and to aid in asbestos identification.

‡ A "Version" indicated by "-x" after the Lab ID# with a value greater than 1 indicates a sample with amended data. The revision number is reflected by the value of "x".

Client: G2 Consultants  
C/O: Drew Rouse  
Re: G25-230; Redmond School District 1335 SW  
Obsidian Ave Redmond, OR

Date of Sampling: 08-13-2025  
Date of Receipt: 08-15-2025  
Date of Report: 08-20-2025

## ASBESTOS PLM REPORT

**Location: G25-230-5, Carpet Adh, Tan (Orange Carpet)**

Lab ID-Version‡: 20937404-1

Sample Layers	Asbestos Content
Tan Mastic (Trace)	ND
<b>Sample Composite Homogeneity:</b>	Moderate

**Location: G25-230-6, CB, Grey + Tan Adh**

Lab ID-Version‡: 20937405-1

Sample Layers	Asbestos Content
Gray Cove Base	ND
<b>Sample Composite Homogeneity:</b>	Good

**Location: G25-230-7, Carpet Adh, Tan (Grey Carpet)**

Lab ID-Version‡: 20937406-1

Sample Layers	Asbestos Content
Tan Mastic	ND
<b>Sample Composite Homogeneity:</b>	Good

**Location: G25-230-8, Carpet Adh, Tan (Grey Carpet)**

Lab ID-Version‡: 20937407-1

Sample Layers	Asbestos Content
Tan Mastic (Trace)	ND
<b>Sample Composite Homogeneity:</b>	Good

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Obsidian Ave Redmond, OR

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## ASBESTOS PLM REPORT

### Location: G25-230-9, Ceramic Tile Grout (Wall)

Lab ID-Version‡: 20937408-1

Sample Layers	Asbestos Content
White Grout	ND
White Non-Fibrous Material	ND
Sample Composite Homogeneity: Good	

### Location: G25-230-10, Ceramic Tile Grout (Wall)

Lab ID-Version‡: 20937409-1

Sample Layers	Asbestos Content
White Grout (Trace)	ND
Sample Composite Homogeneity: Good	

### Location: G25-230-11, Ceramic Tile Grout (Floor)

Lab ID-Version‡: 20937410-1

Sample Layers	Asbestos Content
White Grout	ND
Sample Composite Homogeneity: Good	

### Location: G25-230-12, Ceramic Tile Grout (Floor)

Lab ID-Version‡: 20937411-1

Sample Layers	Asbestos Content
White Grout	ND
Sample Composite Homogeneity: Good	

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 C/O: Drew Rouse  
 Re: G25-230; Redmond School District 1335 SW  
 Obsidian Ave Redmond, OR

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## ASBESTOS PLM REPORT

**Location: G25-230-13, CT. 2'x4' F/P**

Lab ID-Version‡: 20937412-1

Sample Layers	Asbestos Content
Gray Ceiling Tile with White Surface	ND
<b>Composite Non-Asbestos Content:</b>	40% Cellulose 40% Glass Fibers
<b>Sample Composite Homogeneity:</b>	Moderate

**Location: G25-230-14, CT. 2'x4' F/P**

Lab ID-Version‡: 20937413-1

Sample Layers	Asbestos Content
Gray Ceiling Tile with White Surface	ND
<b>Composite Non-Asbestos Content:</b>	40% Cellulose 40% Glass Fibers
<b>Sample Composite Homogeneity:</b>	Moderate

**Location: G25-230-15, FT, 1'x2' Tan Stone Pattern + Clear Adh**

Lab ID-Version‡: 20937414-1

Sample Layers	Asbestos Content
Tan Floor Tile	ND
Transparent Mastic (Trace)	ND
<b>Sample Composite Homogeneity:</b>	Good

**Location: G25-230-16, FT, 1'x2' Tan Stone Pattern + Clear Adh**

Lab ID-Version‡: 20937415-1

Sample Layers	Asbestos Content
Tan Floor Tile	ND
Transparent Mastic (Trace)	ND
<b>Sample Composite Homogeneity:</b>	Good

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 C/O: Drew Rouse  
 Re: G25-230; Redmond School District 1335 SW  
 Obsidian Ave Redmond, OR

Date of Sampling: 08-13-2025  
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## ASBESTOS PLM REPORT

**Location: G25-230-17, CB, 6" Brown + Tan Adh**

Lab ID-Version‡: 20937416-1

Sample Layers	Asbestos Content
Brown Cove Base	ND
Tan Mastic	ND
White Compound (Trace) w/ Paint	ND
<b>Sample Composite Homogeneity:</b> Good	

**Location: G25-230-18, CB, 6" Brown + Tan Adh**

Lab ID-Version‡: 20937417-1

Sample Layers	Asbestos Content
Brown Cove Base	ND
Tan Mastic	ND
White Compound (Trace) w/ Paint	ND
<b>Sample Composite Homogeneity:</b> Good	

**Location: G25-230-19, Carpet Adh, Tan (Orange Carpet)**

Lab ID-Version‡: 20937418-1

Sample Layers	Asbestos Content
Tan Mastic (Trace)	ND
<b>Sample Composite Homogeneity:</b> Good	

**Location: G25-230-20, DW+JC**

Lab ID-Version‡: 20937419-1

Sample Layers	Asbestos Content
White Compound w/ Off-White Paint	ND
Yellow Woven Material	ND
Off-White Drywall with Brown Paper	ND
<b>Composite Non-Asbestos Content:</b>	10% Cellulose 5% Glass Fibers
<b>Sample Composite Homogeneity:</b> Poor	

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Client: G2 Consultants  
C/O: Drew Rouse  
Re: G25-230; Redmond School District 1335 SW  
Obsidian Ave Redmond, OR

Date of Sampling: 08-13-2025  
Date of Receipt: 08-15-2025  
Date of Report: 08-20-2025

## ASBESTOS PLM REPORT

**Location: G25-230-21, DW+JC**

Lab ID-Version‡: 20937420-1

Sample Layers	Asbestos Content
White Compound w/ Off-White Paint	ND
Yellow Woven Material	ND
Off-White Drywall with Brown Paper	ND
<b>Composite Non-Asbestos Content:</b>	10% Cellulose 5% Glass Fibers
<b>Sample Composite Homogeneity:</b>	Poor

**Location: G25-230-22, Plaster Walls on DW Lathe**

Lab ID-Version‡: 20937421-1

Sample Layers	Asbestos Content
White Powdery Material w/ Off-White Paint	ND
<b>Sample Composite Homogeneity:</b>	Good

**Location: G25-230-23, Plaster Walls on DW Lathe**

Lab ID-Version‡: 20937422-1

Sample Layers	Asbestos Content
White Powdery Material w/ Off-White Paint	ND
<b>Sample Composite Homogeneity:</b>	Good

**Location: G25-230-24, Plaster Walls on DW Lathe**

Lab ID-Version‡: 20937423-1

Sample Layers	Asbestos Content
White Powdery Material w/ Off-White Paint	ND
<b>Sample Composite Homogeneity:</b>	Good

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**Eurofins Built Environment Testing West, LLC**  
4321 S. Corbett Ave. Suite A, Portland, OR 97239  
(833) 465-5857 www.eurofinsus.com/Built

Client: G2 Consultants  
C/O: Drew Rouse  
Re: G25-230; Redmond School District 1335 SW  
Obsidian Ave Redmond, OR

Date of Sampling: 08-13-2025  
Date of Receipt: 08-15-2025  
Date of Report: 08-20-2025

## **ASBESTOS PLM REPORT**

### **PROJECT ANALYST AND SIGNATORY REPORT**

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#### **Project Analyst**



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**Analyst:** Alys Bos

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Client: Redmond School District  
 Site Address: 1335 SW Obsidian Ave  
 Redmond, OR 97756

G2 Contact: Drew Rouse  
 Phone #: 971-464-8756



004188598

Page #: 1 of 2  
 G2 Job #: G25-230

Sample Date: 08/13/25

Sampled by: PL

# CHAIN OF CUSTODY RECORD

Turn-Around Time:	Asbestos:	Notes:
<input type="checkbox"/> RUSH 6-Hour <input type="checkbox"/> 24-Hour <input checked="" type="checkbox"/> Standard	<input checked="" type="checkbox"/> PLM <input type="checkbox"/> TEM <input type="checkbox"/> Wipe <input type="checkbox"/> Vac	<input type="checkbox"/> PLM Point Count 400 <input type="checkbox"/> PLM Point Count 1000
*Composite results needed for all drywall and joint compound samples		

Results to: [labresults@g2ci.com](mailto:labresults@g2ci.com)

HM #	Material Description	Sample #	Sample Location	Quantity	Condition	Friable Y/N
17	CARPET ADH., TAN (Grey Carpet)	G25-230-1 2	BAND Room ↓			
10	CB, 4" Blue + TAN ADH	3	↓			
6	CB, 4" BROWN + TAN ADH	4	↓			
18	CARPET ADH, TAN (ORANGE Carpet)	5	↓			
11	CB, Grey, + TAN ADH	6	CLASSROOM 142 ↓			
19	CARPET ADH, TAN (Grey Carpet)	7 8	↓			

Samples Relinquished by: PL

Date and Time: 08/13/25 at 3:36pm

Samples Received by: Ryan Tabor

Date and Time: 8-15-25 9:20

Samples Relinquished by: \_\_\_\_\_

Date and Time: \_\_\_\_\_

Samples Received by: \_\_\_\_\_

Date and Time: \_\_\_\_\_





004188598

HM #	Material Description	Sample #	Sample Location	Quantity	Condition	Frangible Y/N
20	CERAMIC TILE GROUT (wall)	9	CLASSROOM 143	RESTROOM		
21	1" 1" 1" (Floor)	10				
22	CT, 2'x4' F/P	11				
23	FT, (X2) TAN STONE PATTERN, + clear ADH	12				
24	CP, 5" BROWN, + TAN ADH	13	CLASSROOM 143			
18	CARPET ADH, TAN (orange carpet)	14	LIBRARY			
1	DWTS	15	RESTROOMS N/A			
25	PLASTER WALLS O/O DWTS	16				
		17				
		18				
		19	LIBRARY			
		20	Room 142			
		21				
		22				
		23	LIBRARY			
		24				





# Bulk Asbestos Analysis

(EPA Method 40CFR, Part 763, Appendix E to Subpart E and EPA 600/R-93-116, Visual Area Estimation)

NVLAP Lab Code: 101459-0

G2 Consultants Inc.  
Noal Kraft  
16869 SW 65th Avenue  
#15  
Lake Oswego, OR 97035

**Client ID:** L1159  
**Report Number:** B320786  
**Date Received:** 07/21/21  
**Date Analyzed:** 07/23/21  
**Date Printed:** 07/23/21  
**First Reported:** 07/23/21

**Job ID/Site:** 21-5282 - Redmond School District

**SGSFL Job ID:** L1159  
**Total Samples Submitted:** 38  
**Total Samples Analyzed:** 38

**Date(s) Collected:** 07/19/2021

Sample ID	Lab Number	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer
<b>21-5282-1</b>	12451082						
Layer: White Drywall			ND				
Layer: White Joint Compound			ND				
Layer: Paint			ND				
Total Composite Values of Fibrous Components:		Asbestos (ND)					
Cellulose (20 %)	Fibrous Glass (10 %)						
Analyst: KLEAL	Date Analyzed: 07/23/21						
<b>21-5282-2</b>	12451083						
Layer: White Drywall			ND				
Layer: White Joint Compound			ND				
Layer: Paint			ND				
Total Composite Values of Fibrous Components:		Asbestos (ND)					
Cellulose (20 %)	Fibrous Glass (10 %)						
Analyst: KLEAL	Date Analyzed: 07/23/21						
<b>21-5282-3</b>	12451084						
Layer: White Drywall			ND				
Layer: White Joint Compound			ND				
Layer: Paint			ND				
Total Composite Values of Fibrous Components:		Asbestos (ND)					
Cellulose (20 %)	Fibrous Glass (10 %)						
Analyst: KLEAL	Date Analyzed: 07/23/21						
<b>21-5282-4</b>	12451085						
Layer: White Drywall			ND				
Layer: White Joint Compound			ND				
Layer: Paint			ND				
Total Composite Values of Fibrous Components:		Asbestos (ND)					
Cellulose (20 %)	Fibrous Glass (10 %)						
Analyst: KLEAL	Date Analyzed: 07/23/21						

**Client Name:** G2 Consultants Inc.

**Report Number:** B320786

**Date Printed:** 07/23/21

Sample ID	Lab Number	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer
21-5282-5	12451086						
Layer: White Drywall			ND				
Layer: White Joint Compound			ND				
Layer: Paint			ND				
Total Composite Values of Fibrous Components:		Asbestos (ND)					
Cellulose (20 %)	Fibrous Glass (10 %)						
Analyst: KLEAL	Date Analyzed: 07/23/21						
21-5282-6	12451087						
Layer: Tan/Green Mastic			ND				
Total Composite Values of Fibrous Components:		Asbestos (ND)					
Cellulose (Trace)							
Analyst: KLEAL	Date Analyzed: 07/23/21						
21-5282-7	12451088						
Layer: Tan/Green Mastic			ND				
Total Composite Values of Fibrous Components:		Asbestos (ND)					
Cellulose (Trace)							
Analyst: KLEAL	Date Analyzed: 07/23/21						
21-5282-8	12451089						
Layer: Tan/Green Mastic			ND				
Total Composite Values of Fibrous Components:		Asbestos (ND)					
Cellulose (Trace)							
Analyst: KLEAL	Date Analyzed: 07/23/21						
21-5282-9	12451090						
Layer: Beige Fibrous Material			ND				
Layer: Paint			ND				
Total Composite Values of Fibrous Components:		Asbestos (ND)					
Cellulose (35 %)	Fibrous Glass (45 %)						
Analyst: KLEAL	Date Analyzed: 07/23/21						
21-5282-10	12451091						
Layer: Beige Fibrous Material			ND				
Layer: Paint			ND				
Total Composite Values of Fibrous Components:		Asbestos (ND)					
Cellulose (35 %)	Fibrous Glass (45 %)						
Analyst: KLEAL	Date Analyzed: 07/23/21						
21-5282-11	12451092						
Layer: Beige Fibrous Material			ND				
Layer: Paint			ND				
Total Composite Values of Fibrous Components:		Asbestos (ND)					
Cellulose (35 %)	Fibrous Glass (45 %)						
Analyst: KLEAL	Date Analyzed: 07/23/21						

**Client Name:** G2 Consultants Inc.

**Report Number:** B320786

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Sample ID	Lab Number	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer
<b>21-5282-12</b>	12451093						
Layer: Beige Fibrous Material			<b>ND</b>				
Layer: Paint			<b>ND</b>				
Total Composite Values of Fibrous Components:		<b>Asbestos (ND)</b>					
Cellulose (75 %)	Fibrous Glass (5 %)						
Analyst: KLEAL	Date Analyzed: 07/23/21						
<b>21-5282-13</b>	12451094						
Layer: Beige Fibrous Material			<b>ND</b>				
Layer: Paint			<b>ND</b>				
Total Composite Values of Fibrous Components:		<b>Asbestos (ND)</b>					
Cellulose (35 %)	Fibrous Glass (45 %)						
Analyst: KLEAL	Date Analyzed: 07/23/21						
<b>21-5282-14</b>	12451095						
Layer: Beige Fibrous Material			<b>ND</b>				
Layer: Paint			<b>ND</b>				
Total Composite Values of Fibrous Components:		<b>Asbestos (ND)</b>					
Cellulose (35 %)	Fibrous Glass (45 %)						
Analyst: KLEAL	Date Analyzed: 07/23/21						
<b>21-5282-15</b>	12451096						
Layer: Beige Fibrous Material			<b>ND</b>				
Layer: Paint			<b>ND</b>				
Total Composite Values of Fibrous Components:		<b>Asbestos (ND)</b>					
Cellulose (35 %)	Fibrous Glass (45 %)						
Analyst: KLEAL	Date Analyzed: 07/23/21						
<b>21-5282-16</b>	12451097						
Layer: Brown Non-Fibrous Material			<b>ND</b>				
Layer: Brown Mastic			<b>ND</b>				
Total Composite Values of Fibrous Components:		<b>Asbestos (ND)</b>					
Cellulose (Trace)							
Analyst: KLEAL	Date Analyzed: 07/23/21						
<b>21-5282-17</b>	12451098						
Layer: Brown Non-Fibrous Material			<b>ND</b>				
Layer: Brown Mastic			<b>ND</b>				
Total Composite Values of Fibrous Components:		<b>Asbestos (ND)</b>					
Cellulose (Trace)							
Analyst: KLEAL	Date Analyzed: 07/23/21						
<b>21-5282-18</b>	12451099						
Layer: White Coating		Chrysotile	<b>7 %</b>				
Total Composite Values of Fibrous Components:		<b>Asbestos (7%)</b>					
Cellulose (Trace)							
Analyst: KLEAL	Date Analyzed: 07/23/21						

**Client Name:** G2 Consultants Inc.

**Report Number:** B320786

**Date Printed:** 07/23/21

Sample ID	Lab Number	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer
<b>21-5282-19</b>	12451100						
Layer: White Coating		Chrysotile	7 %				
Total Composite Values of Fibrous Components:		<b>Asbestos (7%)</b>					
Cellulose (Trace)							
Analyst: KLEAL	Date Analyzed: 07/23/21						
<b>21-5282-20</b>	12451101						
Layer: Grey Tile			ND				
Layer: Tan Mastic			ND				
Total Composite Values of Fibrous Components:		<b>Asbestos (ND)</b>					
Cellulose (Trace)							
Analyst: KLEAL	Date Analyzed: 07/23/21						
<b>21-5282-21</b>	12451102						
Layer: Grey Tile			ND				
Layer: Tan Mastic			ND				
Total Composite Values of Fibrous Components:		<b>Asbestos (ND)</b>					
Cellulose (Trace)							
Analyst: KLEAL	Date Analyzed: 07/23/21						
<b>21-5282-22</b>	12451103						
Layer: White Tile			ND				
Layer: Tan Mastic			ND				
Total Composite Values of Fibrous Components:		<b>Asbestos (ND)</b>					
Cellulose (Trace)							
Analyst: KLEAL	Date Analyzed: 07/23/21						
<b>21-5282-23</b>	12451104						
Layer: White Tile			ND				
Layer: Tan Mastic			ND				
Total Composite Values of Fibrous Components:		<b>Asbestos (ND)</b>					
Cellulose (Trace)							
Analyst: KLEAL	Date Analyzed: 07/23/21						
<b>21-5282-24</b>	12451105						
Layer: Black Non-Fibrous Material			ND				
Layer: Tan Mastic			ND				
Total Composite Values of Fibrous Components:		<b>Asbestos (ND)</b>					
Cellulose (Trace)							
Analyst: KLEAL	Date Analyzed: 07/23/21						
<b>21-5282-25</b>	12451106						
Layer: Black Non-Fibrous Material			ND				
Layer: Tan Mastic			ND				
Total Composite Values of Fibrous Components:		<b>Asbestos (ND)</b>					
Cellulose (Trace)							
Analyst: KLEAL	Date Analyzed: 07/23/21						

**Client Name:** G2 Consultants Inc.

**Report Number:** B320786

**Date Printed:** 07/23/21

Sample ID	Lab Number	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer
<b>21-5282-26</b>	12451107						
Layer: Grey Non-Fibrous Material			<b>ND</b>				
Layer: Tan Mastic			<b>ND</b>				
Total Composite Values of Fibrous Components:		<b>Asbestos (ND)</b>					
Cellulose (Trace)							
Analyst: KLEAL	Date Analyzed: 07/23/21						
<b>21-5282-27</b>	12451108						
Layer: Grey Non-Fibrous Material			<b>ND</b>				
Layer: Tan Mastic			<b>ND</b>				
Total Composite Values of Fibrous Components:		<b>Asbestos (ND)</b>					
Cellulose (Trace)							
Analyst: KLEAL	Date Analyzed: 07/23/21						
<b>21-5282-28</b>	12451109						
Layer: White Texture			<b>ND</b>				
Layer: Paint			<b>ND</b>				
Total Composite Values of Fibrous Components:		<b>Asbestos (ND)</b>					
Cellulose (Trace)							
Analyst: KLEAL	Date Analyzed: 07/23/21						
<b>21-5282-29</b>	12451110						
Layer: White Texture			<b>ND</b>				
Layer: Paint			<b>ND</b>				
Total Composite Values of Fibrous Components:		<b>Asbestos (ND)</b>					
Cellulose (Trace)							
Analyst: KLEAL	Date Analyzed: 07/23/21						
<b>21-5282-30</b>	12451111						
Layer: White Texture			<b>ND</b>				
Layer: Paint			<b>ND</b>				
Total Composite Values of Fibrous Components:		<b>Asbestos (ND)</b>					
Cellulose (Trace)							
Analyst: KLEAL	Date Analyzed: 07/23/21						
<b>21-5282-31</b>	12451112						
Layer: Grey Fibrous Tile			<b>ND</b>				
Layer: Paint			<b>ND</b>				
Total Composite Values of Fibrous Components:		<b>Asbestos (ND)</b>					
Cellulose (2 %)	Fibrous Glass (90 %)						
Analyst: KLEAL	Date Analyzed: 07/23/21						
<b>21-5282-32</b>	12451113						
Layer: Grey Fibrous Tile			<b>ND</b>				
Layer: Paint			<b>ND</b>				
Total Composite Values of Fibrous Components:		<b>Asbestos (ND)</b>					
Cellulose (2 %)	Fibrous Glass (90 %)						
Analyst: KLEAL	Date Analyzed: 07/23/21						

**Client Name:** G2 Consultants Inc.

**Report Number:** B320786

**Date Printed:** 07/23/21

Sample ID	Lab Number	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer
<b>21-5282-33</b>	12451114						
Layer: Beige Fibrous Material			<b>ND</b>				
Layer: Paint			<b>ND</b>				
Total Composite Values of Fibrous Components:		<b>Asbestos (ND)</b>					
Cellulose (65 %)	Fibrous Glass (15 %)						
Analyst: KLEAL	Date Analyzed: 07/23/21						
<b>21-5282-34</b>	12451115						
Layer: Beige Fibrous Material			<b>ND</b>				
Layer: Paint			<b>ND</b>				
Total Composite Values of Fibrous Components:		<b>Asbestos (ND)</b>					
Cellulose (65 %)	Fibrous Glass (15 %)						
Analyst: KLEAL	Date Analyzed: 07/23/21						
<b>21-5282-35</b>	12451116						
Layer: Grey Ceramic Tile			<b>ND</b>				
Layer: Grey Mortar			<b>ND</b>				
Total Composite Values of Fibrous Components:		<b>Asbestos (ND)</b>					
Cellulose (Trace)							
Analyst: KLEAL	Date Analyzed: 07/23/21						
<b>21-5282-36</b>	12451117						
Layer: Grey Ceramic Tile			<b>ND</b>				
Layer: Grey Mortar			<b>ND</b>				
Total Composite Values of Fibrous Components:		<b>Asbestos (ND)</b>					
Cellulose (Trace)							
Analyst: KLEAL	Date Analyzed: 07/23/21						
<b>21-5282-37</b>	12451118						
Layer: Grey Ceramic Tile			<b>ND</b>				
Layer: Grey Grout			<b>ND</b>				
Total Composite Values of Fibrous Components:		<b>Asbestos (ND)</b>					
Cellulose (Trace)							
Analyst: KLEAL	Date Analyzed: 07/23/21						
<b>21-5282-38</b>	12451119						
Layer: Grey Ceramic Tile			<b>ND</b>				
Layer: Grey Grout			<b>ND</b>				
Total Composite Values of Fibrous Components:		<b>Asbestos (ND)</b>					
Cellulose (Trace)							
Analyst: KLEAL	Date Analyzed: 07/23/21						

**Client Name:** G2 Consultants Inc.

**Report Number:** B320786

**Date Printed:** 07/23/21

Sample ID	Lab Number	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer	Asbestos Type	Percent in Layer
-----------	------------	------------------	---------------------	------------------	---------------------	------------------	---------------------



Tad Thrower, Laboratory Supervisor, Hayward Laboratory

**Note:** Limit of Quantification ('LOQ') = 1%. 'Trace' denotes the presence of asbestos below the LOQ. 'ND' = 'None Detected'.

Analytical results and reports are generated by SGS Forensic Laboratories (SGSFL) at the request of and for the exclusive use of the person or entity (client) named on such report. Results, reports or copies of same will not be released by SGSFL to any third party without prior written request from client. This report applies only to the sample(s) tested. Supporting laboratory documentation is available upon request. This report must not be reproduced except in full, unless approved by SGSFL. The client is solely responsible for the use and interpretation of test results and reports requested from SGSFL. SGSFL is not able to assess the degree of hazard resulting from materials analyzed. SGS Forensic Laboratories reserves the right to dispose of all samples after a period of thirty (30) days, according to all state and federal guidelines, unless otherwise specified. All samples were received in acceptable condition unless otherwise noted.



# CHAIN OF CUSTODY RECORD

Page #: 1 of 2  
G2 Job #: 21-5282  
Sample Date: 7-19-21  
Submit Date: 7-20-21  
Sampled By: SF, DR

G2 Client: Redmond School District  
Address: 145 SE Salmon Drive

G2 Contact: Dan Rouse  
Phone #: (503) 701-7325



Jobsite Address:  
1335 SW Obsidian Ave.  
0

Redmond

OR

Asbestos:

☒ PLM ☐ PLM/Point Count 400 ☐ Wipe  
☐ TEM ☐ PLM/Point Count 1000 ☐ Vac

Turn-Around Time: ☐ RUSH ☐ 24-Hour ☒ 48-Hour ☐ 72-Hour

Results to: labresults@g2ci.com

Material Description

HM#	1	DM+DC	21-5282-1	Tech Classroom OFC	Condition	Frable	Quantity
			2	Health Classroom			
			3	Staff Room			
HM#	1		4	SW Restrooms	Condition	Frable	Quantity
			5	Dean of Students Office - outside door			
HM#	2	Carpet Glue, TAN + GREEN	6	Tech Classroom	Condition	Frable	Quantity
			7	Staff Room			
			8	Dean of Students Office			
HM#	3	CT, 2'x4' G/P	9	Tech Classroom	Condition	Frable	Quantity
			10	Staff Room			
			11	Dean of Students Office			
HM#	4	CT, 2'x4' G/P (NEWER REPLACEMENT)	12	Tech Classroom	Condition	Frable	Quantity
			13	Health Classroom			
HM#	5	CT, 2'x4' TEXTURED w/PINKIES (Replacement Tiles)	14	Tech Classroom	Condition	Frable	Quantity
			15				
HM#	6	CB, 4" Brown + DR ADM	16	Tech Classroom	Condition	Frable	Quantity
			17	Staff Room			
HM#	7	Sink UC, WHITE	18	Tech Classroom	Condition	Frable	Quantity
			19	Health Classroom			

Samples Relinquished by: Sean Friend

Date and Time: 7-20-2021 12:00

Samples Received by:

Date and Time:







# Appendix C:

## Certifications & Accreditation



THIS IS TO CERTIFY THAT

**DREW ROUSE**

HAS SUCCESSFULLY COMPLETED THE TRAINING COURSE

for

**ASBESTOS INSPECTOR INITIAL COURSE**

In accordance with TSCA Title II, Part 763, Subpart E, Appendix C of 40 CFR

Course Date: 11/4/2024 - 11/6/2024

Course Location: Portland, OR

Certificate: IN-24-4444C

For verification of the authenticity of this  
certificate contact:  
PBS Engineering and Environmental Inc.  
4412 S Corbett Avenue  
Portland, OR 97239  
503.248.1939

**CCB #SRA0614 24-Hr Training**



24-Hour AHERA Inspector Training; AHERA  
is the Asbestos Hazard Emergency  
Response Act enacting Title II of Toxic  
Substance Control Act (TSCA)

**Expiration Date:** 11/06/2025

A handwritten signature in black ink, appearing to read 'Andy Fridley', written over a horizontal line.

Andy Fridley, Instructor

THIS IS TO CERTIFY THAT

**DANIEL K. ROUSE**

**HAS SUCCESSFULLY COMPLETED THE TRAINING COURSE**

**for**

**ONLINE AHERA ASBESTOS INSPECTOR REFRESHER**

In accordance with TSCA Title II, Part 763, Subpart E, Appendix C of 40 CFR



**CCB #SRA0615 4-Hr Training**

4-Hour Online AHERA Inspector Refresher Training; AHERA is the Asbestos Hazard Emergency Response Act enacting Title II of Toxic Substance Control Act (TSCA)

**Expiration Date:** 06/04/2025

Course Date: 06/04/2024  
Course Location: Online  
Certificate: IRO-24-5295A

For verification of the authenticity of this certificate contact:  
PBS Engineering and Environmental Inc.  
4412 S Corbett Avenue  
Portland, OR 97239  
503.248.1939

A handwritten signature in black ink, reading 'Andy Fridley'.

Andy Fridley, Instructor

END OF SECTION

**SECTION 087100  
DOOR HARDWARE**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Hardware for hollow metal doors.
- B. Lock cylinders for doors that hardware is indicated is specified in other sections.
- C. Weatherstripping and gasketing.

**1.02 RELATED REQUIREMENTS**

- A. Section 081113 - Hollow Metal Doors and Frames.

**1.03 REFERENCE STANDARDS**

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. BHMA A156.1 - Standard for Butts and Hinges; 2021.
- C. BHMA A156.3 - Exit Devices; 2025.
- D. BHMA A156.4 - Door Controls - Closers; 2019.
- E. BHMA A156.5 - Cylinders and Input Devices for Locks; 2020.
- F. BHMA A156.6 - Standard for Architectural Door Trim; 2021.
- G. BHMA A156.8 - Door Controls - Overhead Stops and Holders; 2021.
- H. BHMA A156.16 - Standard for Auxiliary Hardware; 2023.
- I. BHMA A156.18 - Standard for Materials and Finishes; 2020.
- J. BHMA A156.22 - Standard for Gasketing; 2021.
- K. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.
- L. DHI (LOCS) - Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames; 2004.
- M. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- N. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- O. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- P. UL (DIR) - Online Certifications Directory; Current Edition.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.

**1.05 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.
- C. Shop Drawings - Door Hardware Schedule: Submit detailed listing that includes each item of hardware to be installed on each door. Use door numbering scheme as included in Contract Documents.
  - 1. Prepared by or under supervision of Architectural Hardware Consultant (AHC).
  - 2. List groups and suffixes in proper sequence.
  - 3. Provide complete description for each door listed.



4. Provide manufacturer name, product names, and catalog numbers; include functions, types, styles, sizes and finishes of each item.
5. Include account of abbreviations and symbols used in schedule.
- D. Shop Drawings - Electrified Door Hardware: Submit diagrams for power, signal, and control wiring for electrified door hardware that include details of interface with building safety and security systems. Provide elevations and diagrams for each electrified door opening as follows:
  1. Prepared by or under supervision of Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC).
  2. Elevations: Submit front and back elevations of each door opening showing electrified devices with connections installed and an operations narrative describing how opening operates from either side at any given time.
  3. Diagrams: Submit point-to-point wiring diagram that shows each device in door opening system with related colored wire connections to each device.
- E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- F. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
  1. Submit manufacturer's parts lists and templates.
- G. Keying Schedule:
  1. All cylinders and keying to be provided by Owner.
- H. Specimen warranty.
- I. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.
- J. Maintenance Materials and Tools: Furnish the following for Owner's use in maintenance of project.
  1. See Section 016000 - Product Requirements, for additional provisions.

#### **1.06 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified for commercial door hardware with at least three years of documented experience.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

#### **1.08 WARRANTY**

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer's Warranty: Provide warranty against defects in material and workmanship for period indicated. Complete forms in Owner's name and register with manufacturer.
  1. Closers: 30 years, minimum.
  2. Exit Devices: 10 years, minimum.
  3. Locksets and Cylinders: 10 years, minimum.
  4. Other Hardware: Two years, minimum.

### **PART 2 PRODUCTS**

#### **2.01 DESIGN AND PERFORMANCE CRITERIA**

- A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.
- B. Provide individual items of single type, of same model, and by same manufacturer.
- C. Provide door hardware products that comply with the following requirements:

1. Applicable provisions of federal, state, and local codes.
  2. Accessibility: ADA Standards and ICC A117.1.
  3. Applicable provisions of NFPA 101.
  4. Hardware Preparation for Steel Doors and Steel Frames: BHMA A156.115.
  5. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified.
- D. Lock Function: Provide lock and latch function numbers and descriptions of manufacturer's series. See Door Hardware Schedule.
- E. Fasteners:
1. Provide fasteners of proper type, size, quantity, and finish that comply with commercially recognized standards for proposed applications.
    - a. Aluminum fasteners are not permitted.
    - b. Provide phillips flat-head screws with heads finished to match door surface hardware unless otherwise indicated.

## **2.02 MANUFACTURER AND ACCEPTABLE SUBSTITUTES:**

Item:	Manufacturer:	Substitute:
A. Hinges/Butts:	Ives (IVE)	Stanley, McKinney
B. Locks/Latches:	Schlage (SCH)	None- Owner standard
C. Cylinders:	Medeco (MED)- Provided by Owner.	
D. Exit Devices:	Von Duprin (VON)	None- Owner standard
E. Surface Closers:	LCN (LCN)	None- Owner standard
F. Stops/Catches:	Ives (IVE)	Trimco
G. Kickplates:	Ives (IVE)	Trimco, Tice
H. Weatherstripping/Gasketing:	Zero (ZER)	National Guard, Pemko
I. Door Bottoms:	Zero (ZER)	National Guard, Pemko
J. Thresholds:	Zero (ZER)	National Guard, Pemko
K. Silencers:	Ives (IVE)	Trimco

## **2.03 HINGES**

- A. Hinges: Comply with BHMA A156.1, Grade 1.
1. Provide hinges on every swinging door.
  2. Provide following quantity of butt hinges for each door:
    - a. Doors From 60 inches High up to 90 inches High: Three hinges.

## **2.04 EXIT DEVICES**

- A. Exit Devices: Comply with BHMA A156.3, Grade 1.
1. Lever design to match lockset trim.
  2. Provide cylinder with cylinder dogging or locking trim.
  3. Provide exit devices properly sized for door width and height.
  4. Provide strike as recommended by manufacturer for application indicated.
  5. Provide UL (DIR) listed exit device assemblies for fire-rated doors and panic device assemblies for non-fire-rated doors.

## **2.05 LOCK CYLINDERS**

## **2.06 CLOSERS**

- A. Closers: Comply with BHMA A156.4, Grade 1.
1. Type: Surface mounted to door.
  2. Provide door closer on each exterior door.
  3. Where an overlapping astragal is included on pairs of swinging doors, provide coordinator to ensure door leaves close in proper order.

## **2.07 KICK PLATES**

- A. Kick Plates: Provide along bottom edge of push side of every door with closer, except aluminum storefront and glass entry doors, unless otherwise indicated.
  - 1. Size: 12 inch high by 2 inch less door width (LDW) on push side of door.

## **2.08 WALL STOPS**

- A. Wall Stops: Comply with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.
  - 1. Type: Bumper, concave, wall stop.
  - 2. Material: Aluminum housing with rubber insert.

## **2.09 WEATHERSTRIPPING AND GASKETING**

- A. Weatherstripping and Gasketing: Comply with BHMA A156.22.
  - 1. Head and Jamb Type: Stick-on, silicone.
  - 2. Door Sweep Type: Encased in retainer.

## **2.10 FINISHES**

- A. Finishes: Provide door hardware of same finish, unless otherwise indicated.
  - 1. Primary Finish: 626; satin chromium plated over nickel, with brass or bronze base material (former US equivalent US26D); BHMA A156.18.

# **PART 3 EXECUTION**

## **3.01 EXAMINATION**

- A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.
- B. Verify that electric power is available to power operated devices and of correct characteristics.

## **3.02 INSTALLATION**

- A. Install hardware in accordance with manufacturer's instructions and applicable codes.
- B. Use templates provided by hardware item manufacturer.
- C. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list; unless noted otherwise in Door Hardware Schedule or on drawings.
  - 1. For Steel Doors and Frames: Install in compliance with DHI (LOCS) recommendations.
  - 2. For Steel Doors and Frames: See Section 081113.
  - 3. Mounting heights in compliance with ADA Standards:
    - a. Locksets: 40-5/16 inch.
    - b. Push Plates/Pull Bars: 42 inch.
    - c. Exit Devices: 40-5/16 inch.

## **3.03 FIELD QUALITY CONTROL**

- A. Perform field inspection and testing under provisions of Section 014000 - Quality Requirements.

## **3.04 ADJUSTING**

- A. Adjust work under provisions of Section 017000 - Execution and Closeout Requirements.
- B. Adjust hardware for smooth operation.
- C. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

## **3.05 CLEANING**

- A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.
- B. Clean adjacent surfaces soiled by hardware installation.

- C. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.
- D. See Section 017419 - Construction Waste Management and Disposal for additional requirements.

### 3.06 PROTECTION

- A. Protect finished Work under provisions of Section 017000 - Execution and Closeout Requirements.
- B. Do not permit adjacent work to damage hardware or finish.

### 3.07 DOOR HARDWARE SCHEDULE

#### HARDWARE GROUP NO. 01

002A	002B	003A	003B	164	165A
165B	201	D1A	D1B	E01	E02
E03	E04	E05	E06	E07	E08
E13C	T2				

PROVIDE EACH PR DOOR(S) WITH THE FOLLOWING:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
		EXISTING DOOR, FRAME & HARDWARE TO REMAIN		

#### HARDWARE GROUP NO. 02

005	D1C	D1D
-----	-----	-----

PROVIDE EACH PR DOOR(S) WITH THE FOLLOWING:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA KEY REMOVABLE MULLION	KR4954 STAB	689	VON
1	EA FINAL CORE	FURNISHED BY OWNER	626	MED
1	EA MORTISE CYLINDER	PROVIDED BY OWNER	626	MED
2	EA SURFACE CLOSER	4111 EDA	689	LCN
2	EA KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA GASKETING	188SBK PSA	BK	ZER
1	EA MULLION SEAL	8780NBK PSA	BK	ZER
2	EA MEETING ASTRAGAL	8194AA (ONE SET)	AA	ZER
2	EA DOOR SWEEP	8197AA	AA	ZER
1	EA THERMAL BREAK THRESHOLD	626A-223	A	ZER


BALANCE OF HARDWARE  
EXISTING

RE-USE EXISTING PANIC HARDWARE & WIRELESS LEVER TRIM

HARDWARE GROUP NO. 03

11	101 298	101	102A	102B	103
106	107	108A	109	110	112
113	114	117	118A	118B	119
120A	120B	122A	122B	128	134A
134B	136A	138A	141	142A	143A
143B	143C	144A	146A	147	154
169B	169A	170	A10A	A10B	A10C
A10D	B15	C12	C13	C16A	C16B
C16C	C16D				

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:


QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	ENTRANCE LOCK W/ INSIDE INDICATOR	ND53LD RHO IS-LOC		626	SCH
1	EA	FINAL CORE	FURNISHED BY OWNER BALANCE OF HARDWARE EXISTING		626	MED

FIELD VERIFY EXISTING BACKSET AND STRIKE CONDITION BEFORE ORDERING. EXISTING KICKDOWN HOLDER (WHERE INSTALLED) IS A CODE AND ADA VIOLATION AND SHOULD BE REMOVED.

HARDWARE GROUP NO. 04

A19	87	B11	B12	149	158A
158B	163	A3A	A3B	B6	B7
B9	B13	E9B	E13A	T1A	T1B

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	STOREROOM LOCK	ND80LD RHO		626	SCH
1	EA	FINAL CORE	FURNISHED BY OWNER BALANCE OF HARDWARE EXISTING		626	MED

HARDWARE GROUP NO. 05

161	E16	E15	E13D	E13E	D4B
202	D4A	203	D3A	199	D3B
101 275	101 290	101 291	AD101	AD103	AD104
AD105	AD106	AD107	AD108	AD110	AD111
AD112	AD113	AD114	AD115	AD116A	AD116B
AD117	145A	145B	148A	148B	153A
166	167A	167B	168A	168B	B8
B10A	B10B	D5	E1B	E13B	

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
		EXISTING DOOR, FRAME & HARDWARE TO REMAIN		

HARDWARE GROUP NO. 06

108B

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	EXIT X BLANK OUTSIDE ND25D RHO BALANCE OF HARDWARE EXISTING	626	SCH

HARDWARE GROUP NO. 07

136B	138B	150A	150B	155	162
A4A	A4B	B3	B4	B14	B5A
B5B	C18A	C18B	C19	C20	C21A
C21B	C22	E9A	E8B	E10A	

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:


QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	ENTRANCE LOCK ND53LD RHO	626	SCH
1	EA	FINAL CORE FURNISHED BY OWNER BALANCE OF HARDWARE EXISTING	626	MED

FIELD VERIFY EXISTING BACKSET AND STRIKE CONDITION BEFORE ORDERING. EXISTING KICKDOWN HOLDER (WHERE INSTALLED) IS A CODE AND ADA VIOLATION AND SHOULD BE REMOVED.

HARDWARE GROUP NO. 08

142B 144B


PROVIDE EACH PR DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	VANDL STOREROOM LOCK	ND96LD RHO		626	SCH
1	EA	FINAL CORE	FURNISHED BY OWNER BALANCE OF HARDWARE EXISTING		626	MED

HARDWARE GROUP NO. 09

146B


PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	DBL CYL STORE LOCK	ND66L RHO		626	SCH
2	EA	FINAL CORE	FURNISHED BY OWNER BALANCE OF HARDWARE EXISTING		626	MED

HARDWARE GROUP NO. 10

151 152

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:


QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	PRIVACY W/OCCUP. INDICATOR	ND50LD SPA OS-OCC K510-066		626	SCH
1	EA	FINAL CORE	FURNISHED BY OWNER BALANCE OF HARDWARE EXISTING		626	MED

EXISTING DOOR MUST BE REPLACED AS A SEPARATE DEADBOLT IS A CODE VIOLATION (SINGLE FUNCTION EGRESS IS REQUIRED).

HARDWARE GROUP NO. 11

E10B 153

PROVIDE EACH PR DOOR(S) WITH THE FOLLOWING:


QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	STOREROOM LOCK	ND80LD RHO		626	SCH
1	EA	FINAL CORE	FURNISHED BY OWNER BALANCE OF HARDWARE EXISTING		626	MED



HARDWARE GROUP NO. 12

156                      157                      159                      160

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:










QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	PASSAGE SET	ND10S RHO		626	SCH
			BALANCE OF HARDWARE EXISTING			

FIELD VERIFY EXISTING BACKSET AND STRIKE CONDITION BEFORE ORDERING. EXISTING KICKDOWN HOLDER (WHERE INSTALLED) IS A CODE AND ADA VIOLATION AND SHOULD BE REMOVED.

HARDWARE GROUP NO. 13

B16A                      B16B                      E1A

PROVIDE EACH PR DOOR(S) WITH THE FOLLOWING:






QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	FIRE RATED REMOVABLE MULLION	KR9954 STAB		689	VON
1	EA	FIRE EXIT HARDWARE	98-EO-F-499F		626	VON
1	EA	FIRE EXIT HARDWARE	98-L-F-2SI-06-499F		626	VON
2	EA	FINAL CORE	FURNISHED BY OWNER		626	MED
1	EA	MORTISE CYLINDER	PROVIDED BY OWNER		626	MED
1	EA	RIM CYLINDER	PROVIDED BY OWNER		626	MED
1	EA	RIM CYL THUMBTURN	XB11-979		626	SCH
2	EA	SURFACE CLOSER	4111 EDA		689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER
1	EA	MULLION SEAL	8780NBK PSA		BK	ZER
2	EA	MEETING ASTRAGAL	8194AA (ONE SET)		AA	ZER
			BALANCE OF HARDWARE EXISTING			

EXISTING DOORS WILL NEED TO BE REPLACED TO ACCOMMODATE THE NEW HARDWARE.

HARDWARE GROUP NO. 14

B16C

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	FIRE EXIT HARDWARE	98-EO-F		626	VON
1	EA	CLOSER W/STOP ARM	4111 SCUSH		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER

EXIT ONLY.

**END OF SECTION**

**SECTION 102113.19  
PLASTIC TOILET COMPARTMENTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Solid plastic toilet compartments.
- B. Urinal and vestibule screens.

**1.02 RELATED REQUIREMENTS**

- A. Section 061000 - Rough Carpentry: Blocking and supports.
- B. Section 102800 - Toilet, Bath, and Laundry Accessories.

**1.03 REFERENCE STANDARDS**

- A. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on panel construction, hardware, and accessories.
- C. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
- D. Samples: Submit two samples of partition panels, \_\_\_\_ by \_\_\_\_ inch in size illustrating panel finish, color, and sheen.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. See Restroom Partition and Accessory Schedule on Drawing Sheet A8.01

**2.02 PLASTIC TOILET COMPARTMENTS**

- A. See Restroom Partition and Accessory Schedule on Drawing Sheet A8.01

**2.03 ACCESSORIES**

- A. Pilaster Shoes: Stainless steel, satin finish, 3 inches high; concealing floor fastenings.
- B. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
- C. Door Hardware: Stainless steel, manufacturer's standard finish.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify correct spacing of and between plumbing fixtures.
- B. Verify correct location of built-in framing, anchorage, and bracing.

**3.02 INSTALLATION**

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
- B. Maintain 3/8 inch to 1/2 inch space between wall and panels and between wall and end pilasters.
- C. Attach panel brackets securely to walls using anchor devices.
- D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.

**END OF SECTION**

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**SECTION 102800  
TOILET, BATH, AND LAUNDRY ACCESSORIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Commercial toilet accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 093000 - Tiling: Ceramic washroom accessories.
- B. Section 06 10 00 – Rough Carpentry.

**1.03 REFERENCE STANDARDS**

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use; 2022.

**1.04 SUBMITTALS**

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. If Build America, Buy America Act (BABAA) requirements are in place for this Project, the Contractor shall submit certification that all materials and manufactured goods provided under this Technical Specification meet the BABAA requirements. Please refer to **the equipment plan** for specific details on the material and manufactured goods requirements.
- C. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
- D. Accessory schedule.
- E. Shop Drawings: Show rough opening and installation details.
  - 1. Manufacturers standard drawings may be used provided they indicate required information.
- F. Samples: Provide physical sample of 'J' Channel Trim for Mirrors, 3" min. section demonstrating hardware design, quality, and finish.
- G. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

**1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING**

- A. Protect against damage and discoloration.
- B. Do not remove protective covers until final Project clean-up. Deliver keys to Owner's Authorized Representative.

**PART 2 PRODUCTS**

**2.01 COMMERCIAL TOILET ACCESSORIES**

- A. See Restroom Partition and Accessory Schedule on Drawing Sheet A8.01

**2.02 BLOCKING AND BACKING**

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.
- D. Verify that field measurements are as indicated on drawings.

**3.02 INSTALLATION**

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.

**3.03 PROTECTION**

- A. Protect installed accessories from damage due to subsequent construction operations.

**END OF SECTION**

## SECTION 210000 - GENERAL REQUIREMENTS OF FIRE-SUPPRESSION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. The requirements listed in this section are supplemental to the Division 01 General Requirements.
- B. It shall be the responsibility of the Fire Suppression Contractor to examine and refer to Architectural, Civil, Structural, Mechanical, Plumbing, Electrical, and Landscape and specifications for construction conditions which may affect the scope of Fire Suppression work. Inspect the building site and existing facilities for verification of present conditions. Make proper provisions for these conditions in performance of the work and cost thereof.
- C. Fire Suppression work for this project shall include items, articles, materials, and the associated labor mentioned, scheduled or shown in these specifications and in the accompanying drawings.
- D. Furnish and install equipment, materials and any required incidental items required by good practice to complete the systems described herein. Retain subparagraphs below to cross-reference requirements Contractor might expect to find in this Section but are specified in other Sections.

#### 1.2 CODES AND STANDARDS

- A. Work shall meet the requirements of the plans and specifications and shall not be less than the minimum requirements of applicable sections of the latest Codes and Standards of the following Organizations:
  - 1. American Water Works Association (AWWA)
  - 2. National Electrical Code (NEC)
  - 3. National Electrical Manufacturers Association (NEMA)
  - 4. National Fire Protection Association (NFPA)
  - 5. Uniform Plumbing Code (UPC)
  - 6. Occupational Safety & Health Act (OSHA)
  - 7. International Building Code (IBC)
  - 8. International Fire Code (IFC)
  - 9. Requirements of the Serving Utility Company
  - 10. Oregon Structural Specialty Code (OSSC)
  - 11. Oregon Fire Code (OFC)
  - 12. Unified Facilities Criteria (UFC)
  - 13. Local and State Codes and Ordinances

#### 1.3 FEES AND PERMITS

- A. The Fire Suppression Contractor shall pay fees and arrange permits required for work done under their contract and under their supervision by subcontract.
- B. All usage contracts between the Owner and the serving utilities company, such as membership and usage charges or fees, etc., for the purpose of obtaining the services for the utility company shall be applied for and paid for by the Owner.

#### 1.4 MATERIALS AND EQUIPMENT

- A. Manufacturer's trade names and catalog numbers listed are intended to indicate the quality of equipment or materials desired. Manufacturers not listed in the specification will be considered substitutions and must have prior approval.
- B. See Division 01 for Substitutions Procedures. Requests for substitution are to be submitted sufficiently ahead of the deadline, to give ample time for examination. Prior approval request for substitution must indicate the specific item or items to be furnished in lieu of those scheduled, together with complete technical and comparative data on scheduled items and items proposed for substitution.
- C. If the engineer approves any proposed substitution, the approved product will be listed in an addendum. Bidders shall not rely on approval made in any other manner.
- D. Fire Suppression equipment shall be installed with manufacturer's standard finish and color except where specific color, finish or choice is indicated.
- E. High altitude operation: Capacity of equipment is to be sized and manufactured to perform at the elevation of the project site. If not specifically indicated in the equipment schedule or in the specifications provide required accessories and equipment for proper operation at elevation of the project site.
- F. The Contractor shall be responsible for materials and equipment installed under this contract. Contractor shall also be responsible for the protection of materials and equipment of others from damage as a result of their work.
- G. Manufactured material and equipment shall be applied, installed, connected, erected, used, cleaned, and conditioned as directed by manufacturer unless herein specified to the contrary.
- H. The Contractor shall make the required arrangement with General Contractor or Construction Manager for the introduction into the building of equipment too large to pass through finished openings.
- I. Store materials and equipment indoors at the job site or, if this is not possible, store on raised platforms and protect from the weather by means of waterproof covers. Coverings shall permit circulation of air around the materials to prevent condensation of moisture. Screen or cap openings in equipment to prevent the entry of vermin.

#### 1.5 INTENT OF DRAWINGS



- A. Delegated design drawings are diagrammatic and are intended to show hazard and storage commodity classifications. Riser and other diagrams do not necessarily show the physical arrangement of the equipment. Performance drawings shall not be used for obtaining lineal runs of piping, nor shall they be used as shop drawings for piping fabrication or ordering. Discrepancies between plans and actual field conditions shall be brought to the attention of the Architect/Engineer for resolution.

## 1.6 RESPONSIBILITY

- A. Fire Suppression work shall conform to requirements of division 21 specifications.
- B. The Fire Suppression Contractor shall be responsible for the installation of a satisfactory and complete system in accordance with the intent of the drawing and specifications. Provide, at no extra cost, incidental items, materials, accessories, and labor required for completion of the work even though they are not specifically mentioned or indicated on the drawings or in the specifications.
- C. The drawings do not attempt to show complete details of the building construction which affect Fire Suppression; and reference is therefore required to the Architectural, Civil, Structural, Landscape, Plumbing, Mechanical, and Electrical drawings, and specifications and to shop drawings of trades for additional details which affect the installation of the work covered under this Division of the Contract.
- D. Location of Fire Suppression system components shall be checked for conflicts with openings, structural members and components of other systems having fixed locations. In the event of any conflicts, the Architect/Engineer shall be consulted, and their decision shall govern. Necessary changes shall be made at the Contractor's expense.
- E. Determine, and be responsible for, the proper location and character of inserts for hangers, sleeves, and other openings in the construction required for the work and obtain this information well in advance of the construction progress so work will not be delayed.
- F. Final location of inserts, hangers, etc., required for each installation, must be coordinated with facilities required for other installations to prevent interference.
- G. Do not to install work that connects to equipment until such time as complete Shop Drawings of such equipment have been approved by the Architect/Engineer. Any work installed by the Contractor, prior to approval of Shop Drawings, will be at the Contractor's risk.
- H. All modifications and changes required due to installation of substituted equipment shall be made at the contractor's expense.
- I. It shall be the responsibility of the installing contractor to coordinate changes to work by other trades that result from the installation of equipment other than the scheduled equipment.
- J. If the provided equipment is heavier or larger than the scheduled or specified equipment, it shall be the responsibility of the installing contractor to coordinate the required structural changes and pay for any associated cost.

- K. If the provided equipment has different motor characteristics or electrical requirements than the scheduled or specified equipment, it shall be the responsibility of the installing contractor to coordinate the required changes and pay for any associated cost.
- L. If larger or additional electrical conduits are required due to the installation of equipment other than the scheduled or specified equipment it shall be the responsibility of the installing contractor to coordinate the required changes and pay for any associated cost.
- M. If the provided equipment requires different fluid flow rates than the scheduled or specified equipment, it shall be the responsibility of the installing contractor to coordinate required changes including but not limited to pumps, piping, valves, etc. and pay for any associated cost.
- N. During the performance of this Contract, properly protect work from damage and protect the Owner's property from injury or loss. Make good any damage, injury or loss, except such as may be directly due to errors in the Contract Documents or caused by Agents or Employees of the Owner. Adequately protect adjacent property as provided by law and the Contract Documents. Provide and maintain passageways, guard fences, lights and other facilities for protection required by Public Authority or Local conditions.
- O. The Contractor shall be responsible for damages due to the work of their contractors, to the building or its contents, people, etc.

#### 1.7 REVIEW

- A. All work and material are subject to review at any time by the Architect/Engineer or their representative. If the Architect/Engineer or their representative finds material that does not conform to these specifications or that is not properly installed or finished, correct the deficiencies in a manner satisfactory to the Architect/Engineer at the Contractor's expense.

#### 1.8 WORKMANSHIP

- A. Work under this contract shall be performed by workmen skilled in the particular trade, including work necessary to properly complete the installation in a manner to present a neat and finished appearance.
- B. Obtain Architect's/Engineer's approval before performing any cutting on structural members or patching of building surfaces. Any damage to the building or equipment by the Fire Suppression Contractor shall be the responsibility of the Fire Suppression Contractor and shall be repaired by skilled craftsmen of the trades involved at the Contractor's expense.
- C. Chases, openings, sleeves, hangers, anchors, recesses, equipment pads, framing for equipment, provided by others only if so noted on the drawings. Otherwise, they will be provided by the Fire Suppression Contractor for their work.

#### 1.9 COORDINATION

- A. The Fire Suppression Contractor shall plan their work to proceed with a minimum interference with other trades and it shall be their responsibility to inform the General Contractor of openings required in the building structure for installation of work, and to provide sleeves as required. Dimensions of equipment installed and/or provided by others shall be checked in order that correct clearances and connections may be made.
- B. In general, pipes requiring gravity drainage shall be installed first, followed by ductwork, large piping mains and electrical conduit. The location fire Suppression piping, and heads shall be coordinated with other trades to ensure that installations by other trades do not block heads.
- C. Leave sufficient space for the installation of insulation on piping as specified. It is not acceptable to compress pipe or duct insulation for any reason.

#### 1.10 CLEANING

- A. Keep the job site clean. The Fire Suppression Contractor shall remove waste and rubbish associated with their work.
- B. Upon completion of work, remove materials, scraps and debris related to fire suppression work and leave spaces including tunnels, crawlspaces, pipe or duct chases and ceiling plenums clean and orderly.
- C. The Fire Suppression Contractor shall be responsible for cleaning the exterior and interior of equipment prior to start-up. Once equipment has been cleaned it shall be inspected by the Architect/Engineer prior to start-up.
- D. The Fire Suppression Contractor shall provide dust protection of existing materials and equipment as well as new materials and equipment for the duration of the project. Protect existing materials and equipment from damage for the duration of the project. Clean the exterior and interior of existing equipment at the completion of the project.

#### 1.11 TEMPORARY FACILITIES

- A. Offices
  - 1. The Fire Suppression Contractor must have the permission of the Owner and General Contractor or Construction Manager to install a temporary office/job trailer on the project site.
  - 2. Contractor shall completely remove their temporary installations when no longer needed and the premises shall be completely clean, disinfected, patched, and refinished to match adjacent areas.
- B. Ladders and Scaffolds
  - 1. The Fire Suppression Contractor shall provide their own ladders, scaffolds, etc. of for access to their work in various portions of the building as may be required. When no longer needed, they shall be removed by the Contractor.
- C. Protection Devices

1. The Fire Suppression Contractor shall provide and maintain their own necessary barricades, fences, signal lights, etc., required by governing authorities or shown on the drawings. When no longer needed, they shall be removed by the Contractor.

D. TEMPORARY FIRE PROTECTION

1. The Fire Suppression Contractor shall provide necessary first aid and hand fire extinguishers for Class A, B, C, and special hazards as may exist in their own work area only in accordance with good and safe practice and as required by jurisdictional safety authority.

1.12 SUBMITTALS

- A. Submittals shall be required for each piece of equipment, material or product that is referenced within the Division 21 specification sections. Equipment, material or product not listed in the Division 21 specification sections that effects the performance, aesthetic or integrity of the Fire Suppression System shall be included.

B. Submittal Definitions

1. Product Data: Provide manufacturers cut sheets that include general product information including but not limited to: Model Number, physical data, nominal capacities, rough-in requirements.
2. Performance Data: Provide detailed performance and capacities based on project specific requirements including but not limited to: flow rates, capacities, pressure loss, temperatures, fan curves, pump curves, part load performance, sound data, and electrical characteristics.
3. Delegated Design: Provide detailed drawings prepared and stamped by a registered Professional Engineer that detail pertinent design criteria, the materials and products to be installed and the required installation locations.
4. Wiring Diagram: Provide diagrams that identify and detail required field wiring.
5. Color Chart: Provide a physical color chart of material samples required for selection of equipment colors.

C. Submittal Formats:

1. Product Data
  - a. Product data submittals required in division 21 specification sections shall be combined into a single file and submitted under this section as “210000 – Fire Suppression Product Data”. The product data submittal shall contain a table of contents that clearly identifies each specification section and the equipment, material, and products that are contained within. Each specification section shall begin with a title page and contain a hyperlink that corresponds with the table of contents. Each submittal not following this layout will be rejected and returned without review.
2. Shop Drawings
  - a. Shop drawing submittals required in division 21 specification sections shall be combined into a single file and submitted under this section as “210000 – Fire Suppression Shop Drawings”.
3. Calculations

- a. Calculation submittals required in division 21 specification sections shall be combined into a single file and submitted under this section as “210000 – Fire Suppression Calculations”. The calculation submittal shall contain a table of contents that clearly identifies the calculations that are contained within.
4. Include the following information with each submittal:
  - a. Project Name
  - b. Submittal Date
  - c. Name of Architect
  - d. Name of Engineer
  - e. Name of General Contractor or Construction Manager
  - f. Name of Sub-Contractor
  - g. Name of firm or entity that prepared the submittal.
  - h. Unique Submittal Number
  - i. Type of Submittal
  - j. Specification Section
  - k. Name or Mark of equipment or material and detail or drawings reference.
5. Submittals, with the exception of color charts or material samples, shall be electronically transmitted PDFs.

D. Submittal Requirements

1. Submittals shall be complete, clearly show item used, size, dimensions, capacity, rough in, etc., as required for complete review and installation. Manufacturer’s literature showing more than one item shall be clearly marked as to which item is being furnished or it will be rejected and returned without review.
2. Each submittal shall be thoroughly checked by the Contractor for compliance with the Contract Document requirements, accuracy of dimensions, relationship to the work of other trades, and conformance with sound, safe practices as to erection and installation. Each submittal shall then bear a stamp evidencing such checking and shall show corrections made, if any. Submittals requiring extensive corrections shall be revised before submission. Each submittal not stamped and signed by the Contractor evidencing such checking will be rejected and returned without review.
3. 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 on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
4. Review of the shop drawings and literature by the engineer shall not relieve the contractor of responsibility for deviations of the drawings or specifications, nor shall it relieve the contractor of responsibility for errors in the shop drawings or literature. It is the responsibility of the contractor to provide materials and equipment which meet the specifications and job requirements.

1.13 OPERATION AND MAINTENANCE

A. Operation and Maintenance Manuals (O&M Manuals) shall contain:

1. Names and contact information for the Project Architect and Project Engineer.
2. Names and contact information for the General Contractor or Construction Manager.
3. Names and contact information for sub-contractors.

4. Bound copy of NFPA 25 (Standard for Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems) of applicable year.
5. Installation, maintenance, and operating instructions for each piece of equipment.
6. Parts lists
7. Wiring Diagrams
8. Equipment Start-up and inspection certificates
9. Commissioning Reports
10. Copies of Equipment Warranties
11. Copies of Installation Warranties
12. Copies of Submittals
13. Approved Record Drawings

- B. Prior to substantial completion submit an electronic copy of the O&M manual in PDF format to the Architect, Engineer and Owner for Review for approval. The PDF shall be one file with an index and hyperlinks to each section. Individual bound PDFs without automated navigation will be rejected.

#### 1.14 AS-BUILT RECORD DRAWINGS

- A. The Contractor shall furnish to the Owner and Architect/Engineer a marked print showing the location of fire suppression equipment, pipe routing, valves, drains, sprinklers, etc. installed other than as shown on the drawings. Accurate dimensions and elevations shall be indicated from walls, obstructions, and finished floors where there are deviations from the bid documents.
- B. The location of maintenance related items such as access doors, floor drain, isolation valves, filters, etc., shall be highlighted on as-built drawing.

#### 1.15 PLACING SYSTEM INTO OPERATION

- A. Prior to starting of equipment, the Fire Suppression Contractor shall thoroughly inspect the installation and work completed to verify compliance with the contract documents.
- B. Start-up of Fire Suppression equipment shall be completed by factory trained representatives. At the completion of start-up, the factory representative shall submit to the architect and engineer, a start-up report that indicates any problems encountered, potential problems including installation issues, adjustments made or required to be made to ensure proper operation. Any installation deficiencies identified shall be corrected at no additional cost to the owner.

#### 1.16 OWNER TRAINING

- A. The Contractor shall coordinate with owner on fire suppression equipment training.

#### 1.17 WARRANTY

- A. The Contractor shall guarantee that materials and labor installed are new and of first quality and that any material or labor found defective shall be replaced without cost to the Owner within one (1) year after substantial completion of the Contract. The guarantee shall list the date of the beginning of the one (1) year period, which shall be the date that the Substantial Completion Certificate is issued.
- B. See other specification sections for specific warranty information.
- C. Any damage to the building, caused by defective work or material of the Contractor within the above-mentioned period, shall be satisfactorily repaired without cost to the Owner.
- D. The guarantee does not include maintenance of equipment. The Owner shall accept full responsibility for proper operation and maintenance of equipment immediately upon substantial completion and occupancy of the building.
- E. Final acceptance by the Owner shall not occur until operating instructions are mounted in Equipment Rooms and Operating Personnel thoroughly indoctrinated in the operation of fire suppression equipment by the Contractor.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 210000

## SECTION 21 0517 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Sleeves.
  - 2. Sleeve-seal systems.
  - 3. Grout.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. Division 21 Product Data submittals shall be combined into a single file and submitted in accordance with the requirements specified in Section 21 0000 "General Requirements of Fire-Suppression".

### PART 2 - PRODUCTS

#### 2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

#### 2.2 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Advance Products & Systems, Inc.
  - 2. CALPICO, Inc.
  - 3. GPT; an EnPro Industries company.
  - 4. The Metraflex Company.
  - 5. Proco Products, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
  - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 2. Pressure Plates: Carbon steel.
  - 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, Stainless steel of length required to secure pressure plates to sealing elements.

#### 2.3 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

#### 2.4 FIRESTOPPING

- A. Refer to division 7 for firestopping requirements.



### PART 3 - EXECUTION

#### 3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
  - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
  - 2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
  - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

#### 3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

### END OF SECTION 21 0517

## SECTION 21 0523 - GENERAL-DUTY VALVES FOR FIRE-SUPPRESSION PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Iron butterfly valves with indicators.
  - 2. Check valves.
  - 3. Iron OS&Y gate valves.
  - 4. NRS gate valves.
  - 5. Indicator posts.
  - 6. Trim and drain valves.
  - 7. Backflow Preventers.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of valve.
  - 1. Division 21 Product Data submittals shall be combined into a single file and submitted in accordance with the requirements specified in Section 21 0000 "General Requirements of Fire-Suppression".

### PART 2 - PRODUCTS

#### 2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain valves for each valve type from single manufacturer.
- B. ASME Compliance:
  - 1. ASME B16.1 for flanges on iron valves.
  - 2. ASME B1.20.1 for threads for threaded-end valves.
  - 3. ASME B31.9 for building services piping valves.
- C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- D. NFPA Compliance: Comply with NFPA for valves.
- E. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher as required by system pressures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Actuator Types:
  - 1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.
  - 2. Handwheel: For other than quarter-turn trim and drain valves.
  - 3. Handlever: For quarter-turn trim and drain valves NPS 2 and smaller.

#### 2.2 IRON BUTTERFLY VALVES WITH INDICATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Anvil International.
  - 2. Globe Fire Sprinkler Corporation.
  - 3. Tyco Fire Products LP.
  - 4. Victaulic Company.
  - 5. Zurn Industries, LLC.
- B. Description:
  - 1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 112.
  - 2. Minimum Pressure Rating: 175 psig.
  - 3. Body Material: Cast or ductile iron with nylon, EPDM, epoxy, or polyamide coating.
  - 4. Seat Material: EPDM.
  - 5. Stem: Stainless steel.

6. Disc: Ductile iron, nickel plated and EPDM or SBR coated.
7. Actuator: Worm gear or traveling nut.
8. Supervisory Switch: Internal or external.

## 2.3 CHECK VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Anvil International.
2. Globe Fire Sprinkler Corporation.
3. Mueller Co.
4. Tyco Fire Products LP.
5. Victaulic Company.
6. Zurn Industries, LLC.

B. Description:

1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
2. Minimum Pressure Rating: 175 psig.
3. Type: Single swing check.
4. Body Material: Cast iron, ductile iron, or bronze.
5. Clapper: Bronze, ductile iron, or stainless steel with elastomeric seal.
6. Clapper Seat: Brass, bronze, or stainless steel.
7. Hinge Shaft: Bronze or stainless steel.
8. Hinge Spring: Stainless steel.
9. End Connections: Flanged, grooved, or threaded.

## 2.4 IRON OS&Y GATE VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Mueller Co.
2. Victaulic Company.
3. Zurn Industries, LLC.

B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron, or bronze with elastomeric coating.
5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.

## 2.5 INDICATOR POSTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Cast Iron Pipe Company.
2. Kennedy Valve Company; a division of McWane, Inc.
3. Mueller Co.
4. NIBCO INC.

B. Description:

1. Standard: UL 789 and FM Global standard for indicator posts.
2. Type: Underground or Wall.
3. Base Barrel Material: Cast or ductile iron.
4. Extension Barrel: Cast or ductile iron.
5. Cap: Cast or ductile iron.
6. Operation: Wrench.

## 2.6 TRIM AND DRAIN VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Fire Protection Products, Inc.
2. NIBCO INC.
3. United Brass Works, Inc.

B. Description:

1. Minimum Pressure Rating: 250 psig.
2. Body Material: Brass or bronze.
3. Ends: Threaded.
4. Stem: Bronze.
5. Disc: Bronze.
6. Packing: Asbestos free.
7. Handwheel: Malleable iron, bronze, or aluminum.

## 2.7 BACKFLOW PREVENTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ames
2. Deringer
3. Watts
4. Zurn Wilkins
5. Febco

B. Description

1. Standard: UL 1469.
2. Pressure Rating: 175 psig.
3. Ends: Threaded, Grooved, or Flanged.
4. Body Material: Stainless Steel.

## PART 3 - EXECUTION

### 3.1 GENERAL REQUIREMENTS FOR VALVE INSTALLATION

- A. Install listed fire suppression shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- B. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- C. Install valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above the pipe center.
- E. Install valves in position to allow full stem movement.
- F. Install valve tags. Comply with requirements in Section 21 0553 "Identification for Fire-Suppression Piping and Equipment" for valve tags and schedules and signs on surfaces concealing valves; and the NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.
- G. Install listed fire suppression shutoff valves supervised-open, located to control sources of water supply except from fire-department connections.
- H. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

## END OF SECTION 21 0523

## SECTION 210529 - HANGERS AND SUPPORTS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers, supports, and structural attachments.
2. Trapeze pipe hangers.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Division 21 Product Data submittals shall be combined into a single file and submitted in accordance with the requirements specified in Section 21 0000 "General Requirements of Fire-Suppression".

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports for fire-suppression piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to NFPA 13.
- B. NFPA Compliance: Comply with NFPA 13
- C. UL Compliance: Comply with UL 203.

#### 2.2 STEEL PIPE HANGERS, SUPPORTS, AND STRUCTURAL ATTACHMENTS

- A. Description: Factory-fabricated components, NFPA approved and UL listed or FM approved for fire-suppression piping support.
- B. Galvanized Metallic Coatings: Pre-galvanized or hot-dip galvanized.
- C. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.
- D. Surge Restraints: Extended continuous-thread rod or factor-fabricated components, NFPA approved, UL listed, or FM approved for fire-suppression piping support.

## 2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with NFPA-approved, UL-listed, or FM-approved carbon-steel hanger rods, nuts, saddles, and U-bolts.
- B. Section modulus for trapeze members shall be according to NFPA 13.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with NFPA and IBC requirements for firestopping penetrations through fire-rated walls and ceilings.

### 3.2 INSTALLATION OF HANGERS AND SUPPORTS

- A. Metal Pipe-Hanger Installation: Comply with installation requirements of approvals and listings. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with installation requirements of approvals and listings. Install trapeze hangers, supports, clamps, and attachments are required to properly support piping from building structure.

### 3.3 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe as required.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### 3.4 HANGER AND SUPPORT SCHEDULE

- A. See drawings for hanger types.

END OF SECTION 210529

## SECTION 21 0548 - SEISMIC CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Seismic bracing.
  - 2. Seismic restraint.
  - 3. Flexible couplings.

#### 1.2 DEFINITIONS

- A. IBC: International Building Code.
- B. NFPA: National Fire Protection Association.
- C. ASCE: American Society of Civil Engineers.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Division 21 Product Data submittals shall be combined into a single file and submitted in accordance with the requirements specified in Section 21 0000 "General Requirements of Fire-Suppression".
- B. Calculations: For each seismic bracing device.
  - 1. Include design calculations and details for selecting seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 2. Division 21 Calculation submittals shall be combined into a single file and submitted in accordance with the requirements specified in Section 21 0000 "General Requirements of Fire-Suppression".

#### 1.4 QUALITY ASSURANCE

- A. Comply with seismic requirements in the IBC, NFPA, and ASCE unless requirements in this Section are more stringent.
- B. Seismic devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
- C. Designer Qualifications:
  - 1. When a delegated design is required, preparation of working plans and calculations shall be completed by a qualified NICET Level III designer or professional engineer using performance requirements and design criteria indicated.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. See drawings for seismic design criteria.

#### 2.2 SEISMIC BRACING

- 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. Eaton (Tolco).
  - 2. ASC Engineered Solutions
  - 3. PHD Manufacturing
  - 4. Hilti, Inc.
  - 5. nVent (CADDY).

### 2.3 SEISMIC RESTRAINT

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. Eaton (Tolco).
2. ASC Engineered Solutions
3. PHD Manufacturing
4. Hilti, Inc.
5. nVent (CADDY).
6. Other methods in accordance with NFPA 13.

### 2.4 FLEXIBLE COUPLINGS

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. Victaulic
2. Tyco
3. Reliable
4. ASC Engineered Solutions

## PART 3 - EXECUTION

### 3.1 SEISMIC DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware.

B. Seismic Bracing:

1. Install seismic bracing using methods approved by the applicable codes and standards and the local authority having jurisdiction.

C. Seismic Restraint:

1. Install seismic restraint using methods approved by the applicable codes and standards and the local authority having jurisdiction.

D. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at top flanges of beams, upper truss chords of bar joists, or at concrete members.

E. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

### 3.2 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible couplings in accordance with NFPA 13.

## END OF SECTION 21 0548



## SECTION 21 0553 - IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Pipe labels.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Division 21 Product Data submittals shall be combined into a single file and submitted in accordance with the requirements specified in Section 21 0000 "General Requirements of Fire-Suppression".

### PART 2 - PRODUCTS

#### 2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
  - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
  - 2. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
  - 3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  - 4. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
  - 5. Fasteners: Stainless-steel rivets or self-tapping screws.
  - 6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- C. Equipment-Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

#### 2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Red.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- I. Label Content: Include caution and warning information, plus emergency notification instructions.

## 2.3 PIPE LABELS

- 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. Seton Identification Products.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service and showing flow direction.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- D. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
  1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
  2. Lettering Size: At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

### 3.2 LABEL INSTALLATION REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be installed.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install or permanently fasten labels on each major item of mechanical equipment.
- D. Locate equipment labels where accessible and visible.
- E. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  1. Near each valve and control device.
  2. Near each branch connection excluding short takeoffs. Where flow pattern is not obvious, mark each pipe at branch.
  3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
  4. At access doors, manholes, and similar access points that permit a view of concealed piping.
  5. Near major equipment items and other points of origination and termination.
  6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

**END OF SECTION 21 0553**

## SECTION 21 1313 - WET-PIPE SPRINKLER SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Pipes, fittings, and specialties.
  - 2. Specialty valves.
  - 3. Sprinklers.
  - 4. Pressure gauges.

#### 1.2 ACTION SUBMITTALS

- A. Shop Drawings: For wet-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and by the qualified NICET Level III designer or professional engineer responsible for their preparation.
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Drawn to scale on which items of other systems and equipment are shown and coordinated with each other.
  - 3. Division 21 Shop Drawing submittals shall be combined into a single file and submitted in accordance with the requirements specified in Section 21 0000 "General Requirements of Fire-Suppression".
- B. Product Data: For each type of product.
  - 1. Division 21 Product Data submittals shall be combined into a single file and submitted in accordance with the requirements specified in Section 21 0000 "General Requirements of Fire-Suppression".
- C. Calculations: Hydraulic calculations and seismic calculations (where required) for the wet-pipe sprinkler system to comply with performance requirements and design criteria.
  - 1. Division 21 Calculation submittals shall be combined into a single file and submitted in accordance with the requirements specified in Section 21 0000 "General Requirements of Fire-Suppression".

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- B. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Installer's responsibilities include fabricating and installing sprinkler systems
- B. Designer Qualifications:
  - 1. When a delegated design is required, preparation of working plans and calculations shall be completed by a qualified NICET Level III designer or professional engineer using performance requirements and design criteria indicated.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
  - 1. NFPA 13.

2. Local Authority Having Jurisdiction.
- B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- C. Fire Sprinkler System design shall be approved by the authority having jurisdiction. Provide approval letter from the authority having jurisdiction to the engineer prior to installation.
- D. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
- E. Sprinkler Occupancy Hazard Classifications: According to NFPA 13 unless otherwise indicated.
- F. Maximum Protection Area per Sprinkler: According to NFPA and UL listing.
- G. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according NFPA 13 and ASCE 7.

## 2.2 STEEL PIPE AND FITTINGS

- A. Schedule 40 - Galvanized and Black-Steel Pipe: ASTM A 135/795, Type E, Grade A. Pipe ends may be factory or field formed to match joining method.
- B. Schedule 10, Galvanized and Black-Steel Pipe: ASTM A 135/795, Type E, Grade A. Pipe ends may be factory or field formed to match joining method.
- C. Cast-Iron Threaded Fittings: ANSI B16.4, Class 125, Standard Pattern. Threads shall conform to ANSI B1.20.1
- D. Malleable-Iron Threaded Fittings: ANSI B16.3, Class 150, Standard Pattern. Threads shall conform to ANSI B1.20.1.
- E. Ductile-Iron Threaded Fittings: ANSI B16.42, Class 300, Standard Pattern. Threads shall conform to ANSI B1.20.1.
- F. Cast-Iron Flanges: ASME 16.1, Class 125.
- G. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
  1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick ASME B16.21, nonmetallic and asbestos free or EPDM rubber gasket.
    - a. Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
    - b. Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.
- H. Grooved-Joint, Steel-Pipe Appurtenances:
  1. Galvanized or Painted Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting, with dimensions matching steel pipe.
  2. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

## 2.3 SPECIALTY VALVES

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- B. Specialty Valves Pressure Rating: 175-psig minimum.
- C. Body Material: Cast or ductile iron.
- D. Size: Same as connected piping.
- E. End Connections: Flanged, threaded, or grooved.
- F. Riser Manifolds:
  1. Standard: UL 193.
  2. Design: For horizontal or vertical installation.
  3. Include trim sets for test and drain valve, gauge, pressure relief valve, flow switch, and test orifice in accordance with NFPA 13.
- G. Automatic (Ball Drip) Drain Valves:
  1. Standard: UL 1726.
  2. Pressure Rating: 175-psig minimum.
  3. Type: Automatic draining, ball check.

## 2.4 SPRINKLER PIPING SPECIALTIES

- A. Branch Outlet Fittings:
  - 1. Standard: UL 213.
  - 2. Pressure Rating: 300 psig .
  - 3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
  - 4. Type: Mechanical-tee and -cross fittings.
  - 5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
  - 6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
  - 7. Branch Outlets: Grooved, plain-end pipe, or threaded.
- B. Flow Detection and Test Assemblies:
  - 1. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
  - 2. Pressure Rating: 300 psig.
  - 3. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
  - 4. Size: Same as connected piping.
  - 5. Inlet and Outlet: Threaded or grooved.
- C. Branch Line Testers:
  - 1. Standard: UL 199.
  - 2. Pressure Rating: 300 psig.
  - 3. Body Material: Brass.
  - 4. Size: Same as connected piping.
  - 5. Inlet: Threaded.
  - 6. Drain Outlet: Threaded and capped.
  - 7. Branch Outlet: Threaded, for sprinkler.
- D. Sprinkler Inspector's Test Fittings:
  - 1. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
  - 2. Pressure Rating: 300 psig.
  - 3. Body Material: Cast- or ductile-iron housing with sight glass.
  - 4. Size: Same as connected piping.
  - 5. Inlet and Outlet: Threaded.
- E. Flexible Sprinkler Hose Fittings:
  - 1. Standard: UL 1474.
  - 2. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
  - 3. Pressure Rating: 300 psig.
  - 4. Size: Same as connected piping, for sprinkler.
  - 5. Inlet and Outlet: Threaded or grooved.

## 2.5 SPRINKLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Globe Fire Sprinkler Corporation.
  - 2. Reliable Automatic Sprinkler Co., Inc.
  - 3. Tyco Fire & Building Products LP.
  - 4. Victaulic Company.
  - 5. Viking Corporation.
- B. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- C. Pressure Rating for Residential Sprinklers: 175-psig minimum.
- D. Pressure Rating for Automatic Sprinklers: 175-psig minimum.
- E. Automatic Sprinklers with Heat-Responsive Element:
  - 1. Early-Suppression, Fast-Response Applications: UL 1767.
  - 2. Nonresidential Applications: UL 199.
  - 3. Residential Applications: UL 1626.

4. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" or "Intermediate" temperature classification rating unless otherwise indicated or required by application.
- F. Sprinkler Finishes: See drawings.
- G. Sprinkler Escutcheons: See drawings.
- H. Sprinkler Guards:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Reliable Automatic Sprinkler Co., Inc.
    - b. Tyco Fire & Building Products LP.
    - c. Victaulic Company.
    - d. Viking Corporation.
  2. Standard: UL 199.
  3. Type: Wire cage with fastening device for attaching to sprinkler.

## 2.6 PRESSURE GAUGES

- A. Standard: UL 393.
- B. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- C. Pressure Gauge Range: 0- to 250-psig minimum.
- D. Label: Include "WATER" label on dial face.

## PART 3 - EXECUTION

### 3.1 SERVICE-ENTRANCE PIPING

- A. Install shutoff valve, backflow preventer, pressure gauge, drain, and other accessories indicated at connection to water-service piping.
- B. Install shutoff valve, check valve, pressure gauge, and drain at connection to water service.

### 3.2 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
  1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect or Engineer before deviating from approved working plans.
  2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.
- C. Install seismic bracing and restraint on piping. Comply with NFPA 13 and ASCE 7 requirements.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve with threaded-end connections.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment with grooved end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install sprinkler control valves, check valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. Install alarm devices in piping systems.
- K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- L. Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gauges with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they are not subject to freezing.

- M. Fill sprinkler system piping with water.
- N. Install sleeves for piping penetrations of walls, ceilings, and floors as required.
- O. Install sleeve seals for piping penetrations of concrete walls and slabs as required.

### 3.3 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes with threaded end connections.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment with grooved end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- J. Steel-Piping, Roll-Grooved Joints: Roll groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- K. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

### 3.4 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire suppression valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire suppression shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
  - 1. Install valves in approved position for proper direction of flow, in main supply to system.
  - 2. Install alarm valves with bypass check valve and retarding chamber drain-line connection.

### 3.5 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

### 3.6 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals.

### 3.7 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
  - 4. Energize circuits to electrical equipment and devices.
  - 5. Coordinate with fire-alarm tests. Operate as required.
  - 6. Coordinate with fire-pump tests. Operate as required.
  - 7. Verify that equipment hose threads are same as local fire department equipment.
- B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.8 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

**END OF SECTION 21 1313**



## SECTION 22 00 00 - GENERAL REQUIREMENTS OF PLUMBING

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. The requirements listed in this section are supplemental to the Division 01 General Requirements.
- B. It shall be the responsibility of the Plumbing Contractor to examine and refer to all Architectural, Civil, Structural, Electrical, and Landscape and specifications for construction conditions which may affect the scope of Plumbing work. Inspect the building site and existing facilities for verification of present conditions. Make proper provisions for these conditions in performance of the work and cost thereof.
- C. Plumbing work for this project shall include all items, articles, materials and the associated labor mentioned, scheduled or shown in these specifications and in the accompanying drawings.
- D. Furnish and install all equipment, materials and any required incidental items required by good practice to complete the systems described herein.

#### 1.02 CODES AND STANDARDS

- A. Work shall meet the requirements of the plans and specifications and shall not be less than the minimum requirements of applicable sections of the latest Codes and Standards of the following Organizations:
  - 1. American Gas Association (AGA)
  - 2. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
  - 3. American Society of Mechanical Engineers (ASME)
  - 4. American Water Works Association (AWWA)
  - 5. Oregon Electrical Specialty Code (OESC)
  - 6. National Electrical Manufacturers Association (NEMA)
  - 7. National Fire Protection Association (NFPA)
  - 8. Oregon Plumbing Specialty Code (OPSC)
  - 9. Occupational Safety & Health Act (OSHA)
  - 10. Plastic Pipe Institute (PPI)
  - 11. Oregon Mechanical Specialty Code (OMSC)
  - 12. Oregon Structural Specialty Code (OSSC)
  - 13. Oregon Energy Efficiency Specialty Code (OEESC)
  - 14. Requirements of the Serving Utility Company
  - 15. Local and State Codes and Ordinances

#### 1.03 FEES AND PERMITS

- A. The Plumbing Contractor shall pay all fees and arrange all permits required for work done under their contract and under their supervision by subcontract.

- B. All usage contracts between the Owner and the serving utilities company, such as membership and usage charges or fees, etc., for the purpose of obtaining the services for the utility company shall be applied for and paid for by the Owner.

#### 1.04 MATERIALS AND EQUIPMENT

- A. Manufacturer's trade names and catalog numbers listed are intended to indicate the quality of equipment or materials desired. Manufacturers not listed in the specification will be considered substitutions and must have prior approval.
- B. See Division 01 for Substitutions Procedures. Requests for substitution are to be submitted sufficiently ahead of the deadline, to give ample time for examination. Prior approval request for substitution must indicate the specific item or items to be furnished in lieu of those scheduled, together with complete technical and comparative data on scheduled items and items proposed for substitution.
- C. If the engineer approves any proposed substitution, the approved product will be listed in an addendum. Bidders shall not rely on approval made in any other manner.
- D. Plumbing equipment may be installed with manufacturer's standard finish and color except where specific color, finish or choice is indicated. If the manufacturer has no standard finish, equipment shall have a prime coat and two finish coats of gray enamel.
- E. High altitude operation: Capacity of all equipment is to be sized and manufactured to perform at the elevation of the project site. If not specifically indicated in the equipment schedule or in the specifications provide all required accessories and equipment for proper operation at elevation of the project site.
- F. This Contractor shall be responsible for materials and equipment installed under this contract. Contractor shall also be responsible for the protection of materials and equipment of others from damage as a result of his work.
- G. Manufactured material and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by manufacturer unless herein specified to the contrary.
- H. This Contractor shall make the required arrangement with the General Contractor or Construction Manager for the introduction into the building of equipment too large to pass through finished openings.
- I. Store materials and equipment indoors at the job site. If this is not possible, store on raised platforms and protect from the weather by means of waterproof covers. Coverings shall permit circulation of air around the materials to prevent condensation of moisture. Screen or cap openings in equipment to prevent the entry of vermin.

#### 1.05 INTENT OF DRAWINGS

- A. The drawings are diagrammatic and do not necessarily show exact location of piping and ductwork unless specifically dimensioned. Riser and other diagrams are schematic and do not necessarily show the physical arrangement of the equipment. They shall not be used for obtaining lineal runs of piping or ductwork, nor shall they be used for shop drawings for piping and ductwork fabrication or ordering. Discrepancies shown on different plans, or between plans and actual field conditions shall be brought to the attention of the Architect/Engineer for resolution.

1.06 COMMISSIONING OF SYSTEMS

- A. See Sections 019113 "Commissioning Requirements of Contractor", 220800 "Commissioning of Plumbing", 230800 "Commissioning of HVAC", 260800 "Commissioning of Electrical Systems".

1.07 RESPONSIBILITY

- A. Plumbing work shall conform to requirements of all Division 22 specifications.
- B. The Plumbing Contractor shall be responsible for the installation of a satisfactory and complete system in accordance with the intent of the drawing and specifications. Provide, at no extra cost, all incidental items, materials, accessories and labor required for completion of the work even though they are not specifically mentioned or indicated on the drawings or in the specifications.
- C. The drawings do not attempt to show complete details of the building construction which affect the mechanical and plumbing installation; and reference is therefore required to the Architectural, Civil, Structural, Landscape and Electrical drawings and specifications and to shop drawings of all trades for additional details which affect the installation of the work covered under this Division of the Contract.
- D. Location of mechanical and plumbing system components shall be checked for conflicts with openings, structural members and components of other systems having fixed locations. In the event of any conflicts, the Architect/Engineer shall be consulted, and their decision shall govern. Necessary changes shall be made at the Contractor's expense.
- E. Determine, and be responsible for, the proper location and character of inserts for hangers, chases, sleeves, and other openings in the construction required for the work and obtain this information well in advance of the construction progress so work will not be delayed.
- F. Final location of inserts, hangers, etc., required for each installation, must be coordinated with facilities required for other installations to prevent interference.
- G. Take extreme caution not to install work that connects to equipment until such time as complete Shop Drawings of such equipment have been approved by the Architect/Engineer. Any work installed by the Contractor, prior to approval of Shop Drawings, will be at the Contractor's risk.
- H. All modifications and changes required due to installation of equipment other than the scheduled equipment shall be made at the contractor's expense.
- I. It shall be the responsibility of the installing contractor to coordinate changes to work by other trades that result from the installation of equipment other than the scheduled equipment.
- J. If the provided equipment is heavier or larger than the scheduled or specified equipment, it shall be the responsibility of the installing contractor to coordinate the required structural changes and pay for any and all associated cost.
- K. If the provided equipment has different motor characteristics or electrical requirements than the scheduled or specified equipment, it shall be the responsibility of the installing contractor to coordinate the required changes and pay for any and all associated cost.
- L. If larger or additional electrical conduits, wire or breakers are required due to the installation of equipment other than the scheduled or specified equipment it shall be the responsibility of the

installing contractor to coordinate the required changes and pay for any and all associated cost.

- M. If the provided equipment requires different fluid flow rates than the scheduled or specified equipment, it shall be the responsibility of the installing contractor to coordinate all required changes including but not limited to pumps, piping, valves, etc and pay for any and all associated cost.
- N. At all times during the performance of this Contract, properly protect work from damage and protect the Owner's property from injury or loss. Make good any damage, injury or loss, except such as may be directly due to errors in the Bidding Documents or caused by Agents or Employees of the Owner. Adequately protect adjacent property as provided by law and the Bidding Documents. Provide and maintain passageways, guard fences, lights and other facilities for protection required by Public Authority or Local conditions.
- O. The Contractor shall be responsible for damages incurred due to the work of their contractors, to the building or its contents, people, etc.

#### 1.08 REVIEW

- A. All work and material is subject to review at any time by the Architect/Engineer or his representative. If the Architect/Engineer or his representative finds material that does not conform to these specifications or that is not properly installed or finished, correct the deficiencies in a manner satisfactory to the Architect/Engineer at the Contractor's expense.

#### 1.09 WORKMANSHIP

- A. Work under this contract shall be performed by workmen skilled in the particular trade, including work necessary to properly complete the installation in a workmanlike manner to present a neat and finished appearance.
- B. Obtain Architect's/Engineer's approval before performing any cutting on structural members or patching of building surfaces. Any damage to the building or equipment by the Plumbing Contractor shall be the responsibility of the Plumbing Contractor and shall be repaired by skilled craftsmen of the trades involved at the Contractor's expense.
- C. Chases, openings, sleeves, hangers, anchors, recesses, equipment pads, and framing for equipment; shall be provided by others only if so noted on the drawings. Otherwise, they will be provided by the Mechanical or Plumbing Contractor for their work.

#### 1.10 COORDINATION

- A. The Plumbing Contractor shall plan their work to proceed with a minimum interference with other trades and it shall be their responsibility to inform the General Contractor of all openings required in the building structure for installation of work, and to provide sleeves as required. Dimensions of equipment installed and/or provided by others shall be checked so that correct clearances and connections may be made.
- B. In general, pipelines requiring gravity drainage shall be installed first, followed by ductwork, large piping mains and electrical conduit. The location of fire protection piping and heads shall be coordinated with other trades to ensure that installations by other trades do not block heads.

- C. Leave sufficient space for the installation of insulation on piping and ductwork as specified. It is not acceptable to compress pipe or duct insulation for any reason.

#### 1.11 CLEANING

- A. Keep the job site clean. The Plumbing Contractor shall remove all waste and rubbish associated with their work.
- B. Upon completion of work, remove materials, scraps and debris related to plumbing and mechanical work and leave all spaces including tunnels, crawlspace, pipe or duct chases and ceiling plenums clean and orderly.
- C. The Plumbing Contractor will be responsible for cleaning the exterior and interior of all equipment prior to start-up. Once all equipment has been cleaned it shall be inspected by the Architect/Engineer prior to start-up.
- D. The Plumbing Contractor shall provide dust protection of existing materials and equipment as well as new materials and equipment for the duration of the project. Protect existing materials and equipment from damage for the duration of the project. Clean the exterior and interior of all existing equipment at the completion of the project.

#### 1.12 TEMPORARY FACILITIES

- A. Offices
  - 1. The Plumbing Contractor must have the permission of the Owner and General Contractor or Construction Manager to install a temporary office/job trailer on the project site.
  - 2. The Contractor shall completely remove his temporary installations when no longer needed and the premises shall be completely clean, disinfected, patched, and refinished to match adjacent areas.
- B. Ladders and Scaffolds
  - 1. The Plumbing Contractor shall provide their own ladders, scaffolds, etc. of substantial construction for access to their work in various portions of the building as may be required. When no longer needed, they shall be removed by the Contractor.
- C. Protection Devices
  - 1. The Plumbing Contractor shall provide and maintain his own necessary barricades, fences, signal lights, etc., required by all governing authorities or shown on the drawings. When no longer needed, they shall be removed by the Contractor.
- D. TEMPORARY FIRE PROTECTION
  - 1. The Plumbing Contractor shall provide all necessary first aid hand fire extinguishers for Class A, B, C and special hazards as may exist in his own work area only in accordance with good and safe practice and as required by jurisdictional safety authority.

#### 1.13 SUBMITTALS

- A. Submittals will be required for each piece of equipment, material or product as noted in the table below. All submittals shall be submitted, reviewed and all discrepancies addressed prior to ordering equipment or starting work. Any equipment ordered without having first completed

the submittal process is done at the risk of the contractor. Any work performed prior to completing the submittal process is done at the risk of the contractor.

B.

Specification Section	Product Data	Performance Data	Shop Drawing	Delegated Design	Wiring Diagram	Color Chart	Sustainability Compliance	Notes
220500	X			X				
220519	X							
220523	X							
220529	X			X				Provide Delegated Design per the requirements of this section
220548	X			X				Provide Delegated Design per the requirements of this section
220553	X							
220716	X							
221116	X							
221119	X							
221120	X	X			X			
221123	X	X						
221316	X						X	
221319	X							
221323	X		X	X				Provide Delegated Design and Shop Drawings per the requirements of this section.
221329	X	X			X			
221413	X						X	
221423	X							
221429	X	X			X			
223300	X	X			X		X	
223400	X	X			X		X	
223401	X	X			X		X	
223402	X	X			X		X	
224100	X	X	X			X	X	

C. Submittal Definitions

1. Product Data: Provide manufacturers' cut sheets that include general product information including but not limited to, model number, physical data, nominal capacities, and rough-in requirements.
2. Performance Data: Provide detailed performance and capacities based on project specific requirements including but not limited to: flow rates, capacities, pressure loss, temperatures, fan curves, pump curves, part load performance, sound data, and electrical characteristics.
3. Shop Drawings: Provide detailed drawings of the equipment showing overall dimensions, location of electrical and piping connection, location of anchorage points, location of electrical and control panels, and all operating, service and maintenance clearances.

4. Delegated Design: Provide detailed drawings prepared and stamped by a registered Professional Engineer, that detail pertinent design criteria, the materials and products to be installed and the required installation locations.
5. Wiring Diagram: Provide diagrams that identify, and detail required field wiring.
6. Color Chart: Provide a physical color chart of material samples required for selection of equipment colors.
7. Sustainability Compliance: Provide literature that indicates a products compliance with LEED or Green Globes. See Division 01 for additional information and requirements.

D. Submittal Formats:

1. Include the following information with each submittal:
  - a. Project Name
  - b. Submittal Date
  - c. Name of Architect
  - d. Name of Engineer
  - e. Name of General Contractor or Construction Manager
  - f. Name of Sub-Contractor
  - g. Name of firm or entity that prepared the submittal
  - h. Unique Submittal Number
  - i. Type of Submittal
  - j. Specification Section
  - k. Name or Mark of equipment or material and detail or drawings reference.
2. All Submittals with the exception of color charts or material samples shall be electronically transmitted PDFs.

E. Submittal Requirements

1. Submittals shall be submitted as a complete specification section. The submittal must include all materials and equipment for that specification section. Submittals for individual materials of equipment will be rejected without review.
2. Submittals shall be complete, clearly show item used, size, dimensions, capacity, rough in, etc., as required for complete check and installation. Manufacturer's literature showing more than one item shall be clearly marked as to which item is being furnished or it will be rejected and returned without review.
3. Each submittal shall be thoroughly checked by the Contractor for compliance with the Contract Document requirements, accuracy of dimensions, relationship to the work of other trades, and conformance with sound, safe practices as to erection and installation. Each submittal shall then bear a stamp evidencing such checking and shall show corrections made, if any. Submittals requiring extensive corrections shall be revised before submission. Each submittal not stamped and signed by the Contractor evidencing such checking will be rejected and returned without review.
4. 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 on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
5. Review of the shop drawings and literature by the engineer shall not relieve the contractor for responsibility for deviations from the drawings or specifications, nor shall it relieve the contractor from responsibility for errors in the shop drawings or literature. It is the responsibility of the contractor to provide materials and equipment which meet the specifications and job requirements.

1.14 OPERATION AND MAINTENANCE MANUALS

- A. Operation and Maintenance Manuals (O&M Manuals) shall contain:
  - 1. Names and contact information for the Project Architect, Project Engineer.
  - 2. Names and contact information for the General Contractor or Construction Manager.
  - 3. Names and contact information for sub-contractors.
  - 4. Installation, maintenance and operating instructions for each piece of equipment.
  - 5. Parts lists
  - 6. Wiring Diagrams
  - 7. Equipment Start-up and inspection certificates
  - 8. Test and Balance Reports
  - 9. Commissioning Reports
  - 10. Copies of Equipment Warranties
  - 11. Copies of Submittals
  - 12. Record Drawings.
- B. Prior to substantial completion, submit an electronic copy of the O&M manual in PDF format to the Architect, Engineer and Owner for Review and approval. The PDF shall be one file with an index and hyperlinks to each section. Individual bound PDFs without automated navigation will be rejected. All O&M data shall be grouped by the equipment type and ordered by the specification numbering.
- C. Prior to final payment a final electronic copy of the O&M manual on an archival quality DVD as well as two printed copies, shall be furnished to the owner. Printed copies shall have commercial quality 8-1/2" x 11" 3-ring binders with tabbed dividers for each section.

#### 1.15 AS-BUILT RECORD DRAWINGS

- A. The Contractor shall furnish to the Owner and Architect/Engineer a marked print showing the location of all concealed or underground pipe or conduit runs and other equipment installed other than as shown on the drawings. Dimension underground lines from established building lines. Indicate all installed pull boxes in conduit runs.
- B. The Contractor shall furnish to the Architect/Engineer a marked print showing the location of all mechanical equipment, plumbing fixtures, piping, ductwork, diffusers, grilles, etc. The location of any item which deviates from the bid documents shall be accurately drawn and dimensioned.
- C. All underground piping and ductwork shall be dimensioned from nearest column and/or exterior walls. The location of all maintenance related items, such as duct access doors, fire dampers, isolation valves, filters, etc., shall be highlighted on the as built drawing.

#### 1.16 PLACING SYSTEM INTO OPERATION

- A. Prior to the starting of equipment, the Plumbing Contractor shall thoroughly inspect the installation and any work completed by other trades and subcontractors to verify compliance with the contract documents.

#### 1.17 OWNER TRAINING

- A. General
  - 1. The system training is intended to familiarize the Owner's operating and maintenance staff with all systems requiring maintenance. Training is to be provided after the



- systems are in place and operational, after issues noted during commissioning have been resolved, and before final acceptance.
2. Provide second set of training sessions for automatic control systems about 6-9 months after the first sessions.
- B. Systems Requiring Training
1. All mechanical, electrical, safety, standby, and automatic control systems in the project, and other systems specified elsewhere to have training.
- C. Attendance:
1. Training is to be provided by contractor's representatives that are familiar with the system's operation and maintenance requirements. Individual training sessions (modules) shall be provided for each type or group of systems, separated roughly by trade group that will be performing maintenance on the system. The trades groups and systems typically requiring training are:
    - a. Plumbers (Domestic and Sanitary Plumbing, gas-fired heating, packaged rooftop units, miscellaneous process piping systems)
- D. Schedule:
1. Duplicate training sessions are to be provided for each training module, so that the Owner's operating personnel can be split into two groups during training. Duplicate training sessions shall be scheduled on different days. Length of training sessions will be determined by scope of training indicated below, and as coordinated with Owner after draft copy of training documents have been reviewed.
- E. Training Documentation:
1. Contractor to submit draft copy of agenda and training documents to Owner for review at least two weeks prior to training date.
  2. Provide a copy of the following items for each person that will be attending the training sessions. Coordinate required number with the Owner.
    - a. Training agenda.
    - b. Summary of new systems and existing systems affected by this project.
    - c. Summary of work performed under this project.
    - d. Control system drawings and sequences of operation.
    - e. List of important maintenance and trouble-shooting operations for all systems.
  3. Provide minimum of 2 copies of following items:
    - a. Contract documents including all drawings, specifications, addendums, and change orders.
- F. Training Sessions:
1. Assemble at location to be determined by the Owner.
  2. Distribute training documentation as indicated above.
  3. Provide classroom style training if required for orientation and discussion of new systems and existing systems affected by this project, and other issues appropriate for a classroom format.
  4. Visit site and review locations; and perform detailed review of operation and maintenance requirements for current systems.

#### 1.18 WARRANTY

- A. The Contractor shall guarantee that all materials and labor installed are new and of first quality and that any material or labor found defective shall be replaced without cost to the Owner

within one (1) year after substantial completion of the Contract or one (1) full season of heating and cooling operation, whichever is the greater. The guarantee shall list the date of the beginning of the one (1) year period, which shall be the date that the Substantial Completion Certificate is issued.

- B. Any damage to the building, caused by defective work or material of the Contractor within the above-mentioned period, shall be satisfactorily repaired without cost to the Owner.
- C. The guarantee does not include maintenance of equipment. The Owner shall accept full responsibility for proper operation and maintenance of equipment immediately upon substantial completion and occupancy of the building.
- D. Final acceptance by the Owner will not occur until all operating instructions are mounted in Equipment Rooms and Operating Personnel are thoroughly indoctrinated in the operation of all mechanical equipment by the Contractor.
- E. No equipment installed as part of this project shall be used for temporary heat during construction.

END OF SECTION 22 00 00

## SECTION 22 05 00 - GENERAL PROVISIONS OF PLUMBING

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section includes the following:
  - 1. Expansion Fittings and Loops for Piping Systems
  - 2. Alignment Guides and Anchors
  - 3. Dielectric Fittings
  - 4. Pipe Sleeves
  - 5. Sleeve Seals Systems for Piping
  - 6. Silicone Sealant
  - 7. Escutcheons for Piping
  - 8. Floor Plates

#### 1.02 SUBMITTALS

- A. See Section 22 00 00 "General Requirements of Plumbing" for Submittal requirements.

#### 1.03 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

#### 1.04 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

### PART 2 - PRODUCTS

#### 2.01 EXPANSION FITTINGS AND LOOPS FOR PIPING SYSTEMS

- A. Rubber Union Connector Expansion Joints
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Engineered Flexible Products EFP
    - b. Mason Industries, Inc.
    - c. MetraFlex.
    - d. Twin City Hose.
    - e. Vibro-Acoustics

2. Material: Twin reinforced-rubber spheres with external restraining cables.
  3. Minimum Pressure Rating: 150 psig at 170 deg F, unless otherwise indicated.
  4. End Connections for NPS 2 and Smaller: Threaded.
- B. Flexible-Hose Packless Expansion Joints:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Engineered Flexible Products EFP
    - b. Mason Industries, Inc.
    - c. Metraflex Company (The).
    - d. Twin City Hose Inc.
    - e. Vibro-Acoustics
  2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
  3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
  4. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint end connections.
    - a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.
  5. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4: Copper-alloy fittings with threaded end connections.
    - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.
  6. Expansion Joints for Steel Piping NPS 2 and Smaller: Carbon-steel fittings with threaded end connections.
    - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70 deg F and 325 psig at 600 deg F ratings.
  7. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6: Carbon-steel fittings with flanged end connections.
    - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F and 145 psig at 600 deg F ratings.
  8. Expansion Joints for DWV and Storm Drainage PVC or Cast Iron Piping NPS 2 and Smaller: Copper-alloy fittings with no hub or flanged end connections.
    - a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.
    - b. UPC listed with cleanout plugs located in the U-Bend
  9. Expansion Joints for DWV and Storm Drainage or Cast Iron Piping NPS 4 to NPS 8: Stainless steel fittings with no hub or flanged end connections.
    - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.
    - b. UPC listed with cleanout plugs located in the U-Bend

## 2.02 ALIGNMENT GUIDES AND ANCHORS

- A. Alignment Guides
1. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding slider for bolting to pipe.
- B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
  - a. Stud: Threaded, zinc-coated carbon steel.
  - b. Expansion Plug: Zinc-coated steel.
  - c. Washer and Nut: Zinc-coated steel.
5. Chemical Fasteners: Insert-type stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
  - a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
  - b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
  - c. Washer and Nut: Zinc-coated steel.

## 2.03 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
  1. Dielectric Unions are not allowed.
- C. Dielectric Flanges:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
    - b. Central Plastics Company.
    - c. Matco-Norca.
    - d. Watts; a division of Watts Water Technologies, Inc.
    - e. Wilkins; a Zurn company.
  2. Standard: ASSE 1079.
  3. Factory-fabricated, bolted, companion-flange assembly.
  4. Pressure Rating: 175 psig.
  5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Central Plastics Company.
    - d. Pipeline Seal and Insulator, Inc.
  2. Nonconducting materials for field assembly of companion flanges.
  3. Pressure Rating: 150 psig.
  4. Gasket: Neoprene or phenolic.
  5. Bolt Sleeves: Phenolic or polyethylene.

6. Washers: Phenolic with steel backing washers.

E. PEX Dielectric Separator:

1. Description: 6" long section of pex piping shall be installed between dis-similar piping materials.
2. Pipe Material: PEX plastic according to ASTM F 876.
3. Oxygen Barrier: O<sub>2</sub> permeability  $\leq 0.32$  mg/m<sup>2</sup>/day in accordance with DIN 4726.
4. Fittings: ASTM F 1960, cold expansion fittings and reinforcing rings.
5. Pressure/Temperature Rating: Minimum 100 psig and 180 deg F.

2.04 SLEEVES

- A. Galvanized-Steel Sheet Pipe Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.05 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance Products & Systems, Inc.
  2. CALPICO, Inc.
  3. GPT; an EnPro Industries company.
  4. Metraflex Company (The).
- B. Description:
1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
  2. Designed to form a hydrostatic seal of 20-psig.
  3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
  4. Pressure Plates: Composite plastic.
  5. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.06 ASSEMBLY PENETRATIONS

- A. All penetrations through a fire rated assembly shall be protected with an approved fire stop system in compliance with the rated assemblies as outlined in the Underwriters Laboratory Listing.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. 3M Company
    - b. Holdrite
    - c. Hilti

2.07 SILICONE SEALANTS

- A. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C

920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.

2.08 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

2.09 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

PART 3 - EXECUTION

3.01 EXPANSION JOINT INSTALLATION

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.
- B. Install expansion joint per the manufacturer's written instructions.

3.02 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

- A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
- B. Install two guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four (4) pipe diameters from expansion joint.
- C. Attach guides to pipe, and secure guides to building structure.
- D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- E. Anchor Attachments:
  - 1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  - 2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24; U bolts bolted to anchor.
- F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
  - 1. Anchor Attachment to Steel Structural Members: Attach by welding.
  - 2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
- G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

### 3.03 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Install Dielectric fittings per the manufacturers written instructions.
- C. Install pipe hangers immediately upstream and downstream of dielectric fittings.
- D. Install isolation valves immediately upstream and downstream of dielectric fittings.
- E. Dielectric Fittings for NPS 2 and Smaller: PEX Dielectric Separator.
- F. Dielectric Fittings for NPS 2-1/2 and Larger: Dielectric Flange.

### 3.04 SLEEVE INTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
  - 2. Using silicone sealant, seal space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke-Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 07 84 13 "Penetration Firestopping."

### 3.05 SLEEVE-SEALS SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls at piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal-system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

### 3.06 SLEEVE-SEAL SCHEDULE

- A. Use sleeve and sleeve-seals for the following piping-penetration applications:
  - 1. Exterior Concrete Walls Above Grade: Galvanized-Steel Sheet Pipe Sleeves with Sleeve-seal system
  - 2. Exterior Concrete Walls Below Grade: Galvanized-Steel Sheet Pipe Sleeves with Sleeve-seal system
  - 3. Interior or Exterior Concrete Slabs-on-Grade: Sleeve not required.



4. Interior Concrete Slabs Above Grade: Galvanized-Steel Sheet Pipe Sleeves with Silicone Sealant or Fire calk
5. Interior Partitions: Sleeve not required – fire calk penetrations of rated assemblies.

3.07 ESCUTCHEON INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

3.08 FLOOR PLATE INSTALLATION

- A. Install floor plates for piping penetrations of equipment-room floors.
- B. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

END OF SECTION 22 05 00

## SECTION 22 05 19 - METERS AND GAGES FOR PLUMBING PIPING

### PART 1 - GENERAL

#### 1.01 RELATED DOCUMENTS

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

#### 1.02 SUMMARY

- A. Section Includes:
  - 1. Bimetallic-actuated thermometers.
  - 2. Thermowells.
  - 3. Dial-type pressure gages.
  - 4. Gage attachments.

#### 1.03 ACTION SUBMITTALS

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

#### 1.04 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of meter and gage.

#### 1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.01 BIMETALLIC-ACTUATED THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ashcroft Inc.
  - 2. Miljoco Corporation.
  - 3. Tel-Tru Manufacturing Company.
  - 4. Terice, H. O. Co.
  - 5. Prior Approved Equal
- B. Standard: ASME B40.200.
- C. Case: Liquid-filled and sealed type(s); stainless steel with 3-inch nominal diameter.
- D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F.

- E. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.
- F. Connector Size: 1/2 inch, with ASME B1.1 screw threads.
- G. Stem: 0.25 or 0.375 inch in diameter; stainless steel.
- H. Window: Plain glass.
- I. Ring: Stainless steel.
- J. Element: Bimetal coil.
- K. Pointer: Dark-colored metal.
- L. Accuracy: Plus or minus 1 percent of scale range.

## 2.02 THERMOWELLS

- A. Thermowells:
  - 1. Standard: ASME B40.200.
  - 2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
  - 3. Material for Use with Copper Tubing: CNR or CUNI.
  - 4. Material for Use with Steel Piping: CRES or CSA.
  - 5. Type: Stepped shank unless straight or tapered shank is indicated.
  - 6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
  - 7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
  - 8. Bore: Diameter required to match thermometer bulb or stem.
  - 9. Insertion Length: Length required to match thermometer bulb or stem.
  - 10. Lagging Extension: Include on thermowells for insulated piping and tubing.
  - 11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
- B. Heat-Transfer Medium: Mixture of graphite and glycerin.

## 2.03 PRESSURE GAGES

- A. Direct-Mounted and Remote, Metal-Case, Dial-Type Pressure Gages:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Ashcroft Inc.
    - b. Miljoco Corporation.
    - c. Tel-Tru Manufacturing Company.
    - d. Trerice, H. O. Co.
    - e. Prior Approved Equal
  - 2. Standard: ASME B40.100.
  - 3. Case: Liquid-filled, Sealed type(s); 4-1/2-inch nominal diameter.
  - 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
  - 5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
  - 6. Movement: Mechanical, with link to pressure element and connection to pointer.
  - 7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
  - 8. Pointer: Dark-colored metal.
  - 9. Window: Glass.

- 10. Ring: Metal.
- 11. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

#### 2.04 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston or porous-metal-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

- A. Install thermowells with socket extending a minimum of 2 inches into fluid and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
- G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- H. Install remote-mounted pressure gages on panel.
- I. Install valve and snubber in piping for each pressure gage for fluids.
- J. Install thermometers in the following locations:
  - 1. Inlet and outlet of each domestic water heater.
  - 2. Inlet and outlet of each domestic hot-water storage tank.
  - 3. Two inlets and two outlets of each heat pump.
  - 4. Inlet and outlet of each hydronic coil in air-handling units.
  - 5. Inlet and outlet of each thermal-storage tank.
  - 6. Inlet and outlet of each refrigeration condenser.
- K. Install pressure gages in the following locations:
  - 1. Building water service entrance into building.
  - 2. Inlet and outlet of each pressure-reducing valve.
  - 3. Suction and discharge of each pump.
- L. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

- M. Adjust faces of meters and gages to proper angle for best visibility.

3.02 THERMOMETER SCALE-RANGE SCHEDULE

- A. Edit section or insert additional paragraphs for pressure-gage applications.
- B. Domestic Cold-Water Piping: 0 to 150 deg F.
- C. Domestic Hot-Water Piping: 50 to 200 deg F.

3.03 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Water Service Piping: 0 to 150 psi.
- B. Domestic Water Piping: 0 to 100 psi.

END OF SECTION 22 05 19

## SECTION 22 05 23 - GENERAL DUTY VALVES FOR PLUMBING

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section includes:
  - 1. Ball Valves
  - 2. Butterfly Valves
  - 3. Bronze Gate Valves
  - 4. Iron Gate Valve
  - 5. Bronze Check Valves
  - 6. Iron Swing Check Valves
  - 7. Iron Silent Check Valves

#### 1.02 SUBMITTALS

- A. See Section 22 00 00 "General Requirements for Plumbing" for submittal requirements.

### PART 2 - PRODUCTS

#### 2.01 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
  - 1. ASME B1.20.1 for threads for threaded-end valves.
  - 2. ASME B16.1 for flanges on iron valves.
  - 3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  - 4. ASME B16.18 for solder-joint connections.
  - 5. ASME B31.1 for power piping valves.
  - 6. ASME B31.9 for building services piping valves.
- C. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- D. Refer to valve schedule articles for applications of valves.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valves in Insulated Piping:
  - 1. Include 2-inch stem extensions.
  - 2. Extended operating handle of nonthermal-conductive material, and protective sleeves that allow operation of valves without breaking the vapor seals or disturbing insulation.
  - 3. Memory stops that are fully adjustable after insulation is applied.

2.02 BRONZE BALL VALVES, TWO-PIECE WITH FULL PORT AND STAINLESS-STEEL TRIM:

A. Manufacturers: Provide products from one of the following:

1. Apollo
2. Nibco
3. Milwaukee
4. Red-White Valves
5. Watts

B. Description:

1. Standard: MSS SP-110.
2. SWP Rating: 150 psig.
3. CWP Rating: 600 psig.
4. Body Design: Two piece.
5. Body Material: Bronze.
6. Ends: Solder or Threaded.
7. Seats: PTFE.
8. Stem: Stainless steel.
9. Ball: Stainless steel, vented.
10. Port: Full.

2.03 IRON, SINGLE-FLANGE BUTTERFLY VALVES WITH ALUMINUM-BRONZE DISC:

A. Manufacturers: Provide products from one of the following:

1. Apollo
2. Milwaukee
3. Nibco
4. Dezurik
5. Red-White Valves
6. Watts

B. Description:

1. Standard: MSS SP-67, Type I.
2. CWP Rating: 150 psig.
3. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
4. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
5. Seat: EPDM.
6. Stem: One- or two-piece stainless steel.
7. Disc: Aluminum bronze.

2.04 BRONZE GATE VALVES, NRS, CLASS 150:

A. Manufacturers: Provide products from one of the following:

1. Apollo
2. Nibco
3. Crane
4. Milwaukee
5. Red-White Valves

B. Description:

1. Standard: MSS SP-80, Type 1.
2. CWP Rating: 300 psig.
3. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
4. Ends: Threaded.
5. Stem: Bronze.
6. Disc: Solid wedge; bronze.
7. Packing: Asbestos free.
8. Handwheel: Malleable iron, bronze, or aluminum.

2.05 IRON GATE VALVES, NRS, CLASS 125:

- A. Manufacturers: Provide product from one of the following:
1. Apollo
  2. Crane
  3. Milwaukee
  4. Nibco
  5. Red-White Valves
  6. Watts
- B. Description:
1. Standard: MSS SP-70, Type I.
  2. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
  3. Body Material: ASTM A 126, gray iron with bolted bonnet.
  4. Ends: Flanged.
  5. Trim: Bronze.
  6. Disc: Solid wedge.
  7. Packing and Gasket: Asbestos free.

2.06 BRONZE SWING CHECK VALVES WITH BRONZE DISC, CLASS 125:

- A. Manufacturer: Provide products from one of the following:
1. Apollo
  2. Crane
  3. Milwaukee
  4. Nibco
  5. Watts
- B. Description:
1. Standard: MSS SP-80, Type 3.
  2. CWP Rating: 200 psig (1380 kPa).
  3. Body Design: Horizontal flow.
  4. Body Material: ASTM B 62, bronze.
  5. Ends: Threaded or soldered. See valve schedule articles.
  6. Disc: Bronze.

2.07 IRON SWING CHECK VALVES WITH METAL SEATS, CLASS 125:

- A. Manufacturers: Provide products from one of the following:
1. Apollo
  2. Crane



3. Milwaukee
4. Mueller
5. Nibco
6. Red-White Valves

B. Description:

1. Standard: MSS SP-71, Type I.
2. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
3. Body Design: Clear or full waterway.
4. Body Material: ASTM A 126, gray iron with bolted bonnet.
5. Ends: Flanged.
6. Trim: Bronze.
7. Gasket: Asbestos free.

2.08 IRON SILENT CHECK (GLOBE STYLE) WITH METAL SEATS, CLASS 125:

A. Manufacturers: Provide products from one of the following:

1. Metraflex
2. Watts
3. Dezurik
4. Red-White Valves

B. Description:

1. Standard: MSS SP-125
2. NPS 2-1/2 to NPS 12, CWP Rating: 200 psi
3. Body: ASTM 125 Class B, Cast Iron.
4. Seat: ASTM B584 Bronze Alloy
5. Disc: ASTM B584 Bronze Alloy
6. Spring: Stainless Steel Type 316, ASTM A 313
7. Ends: Flanged
8. Trim: Stainless Steel

PART 3 - EXECUTION

3.01 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

3.02 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified SWP classes or CWP ratings are unavailable, the same types of valves with higher SWP classes or CWP ratings may be substituted.

- B. Select valves with the following end connections:
  - 1. For Copper Tubing, NPS ½" – 2" and Smaller: solder ends.
  - 2. For Steel Piping, NPS 2" and Smaller: Threaded ends.
  - 3. For Steel Piping NPS 2-1/2" and larger: Flanged or Grooved ends.

3.03 VALVE SCHEDULE

- A. Domestic Water ½" – 2" NPS: Ball Valve, Solder or Threaded Ends
- B. Domestic Water 2-1/2" NPS and Larger: Butterfly Valve, Lug Type

3.04 CHECK VALVE SCHEDULE

- A. Pump Discharge ½" – 2" NPS: Bronze Swing Check, Threaded or Solder Ends
- B. Pump Discharge 2-1/2" NPS and Larger: Iron Body Globe Style Silent Check, Flanged Ends

END OF SECTION 22 05 23

## SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes:
  - 1. Metal pipe hangers and supports.
  - 2. Trapeze pipe hangers.
  - 3. Thermal-hanger shield inserts.
  - 4. Fastener systems.
  - 5. Pipe positioning systems.
  - 6. Equipment supports.

#### 1.02 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
  - 1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
  - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
  - 3. Design seismic-restraint hangers and supports for piping and equipment.

#### 1.03 SUBMITTALS

- A. See Section 22 00 00 "General Requirements of Plumbing" for submittal requirements.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
  - 1. Trapeze pipe hangers.
  - 2. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.04 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

## PART 2 - PRODUCTS

### 2.01 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Galvanized Metallic Coatings: Pre-galvanized or hot dipped.
  - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
  - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Copper Pipe Hangers:
  - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
  - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

### 2.02 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

### 2.03 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

### 2.04 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 2.05 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

## 2.06 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.

## PART 3 - EXECUTION

### 3.01 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
  - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:
  - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
  - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.

- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- M. Insulated Piping:
  - 1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    - b. NPS 4: 12 inches long and 0.06 inch thick.
    - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
    - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
  - 5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
  - 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.02 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and 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. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.03 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.04 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 09 91 13 "Exterior Painting.", Section 09 91 23 "Interior Painting.", Section 09 96 00 "High-Performance Coatings."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.05 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
  - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
  - 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.

5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  6. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  8. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
  9. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.



- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  - 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
  - 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
- O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- Q. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 22 05 29

SECTION 22 05 48 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
  - 1. Elastomeric isolation pads.
  - 2. Elastomeric isolation mounts.
  - 3. Restrained elastomeric isolation mounts.
  - 4. Open-spring isolators.
  - 5. Housed-spring isolators.
  - 6. Restrained-spring isolators.
  - 7. Housed-restrained-spring isolators.
  - 8. Pipe-riser resilient supports.
  - 9. Resilient pipe guides.
  - 10. Elastomeric hangers.
  - 11. Spring hangers.
  - 12. Snubbers.
  - 13. Restraint channel bracings.
  - 14. Restraint cables.
  - 15. Seismic-restraint accessories.
  - 16. Mechanical anchor bolts.

1.02 ACTION SUBMITTALS

- A. See Section 22 00 00 "General Requirements for Plumbing" for submittal requirements.
- B. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.
  - 1. Include design calculations and details for selecting vibration isolators and seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.03 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads)

to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

## PART 2 - PRODUCTS

### 2.01 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
  - 1. Design seismic restraints for components for seismic design forces defined in Chapter 13 of ASCE 7-16.
    - a. Design Spectral Response Acceleration at Short Periods, See Structural Drawings for Site Specific  $S_{DS}$  Value
    - b. Component Importance Factor,  $I_p = 1.0$ ; except for components conveying, supporting, or otherwise containing natural gas or other flammable and/or explosive contents,  $I_p = 1.5$ .
    - c. Component Response Modification Factor,  $R_p$ : See Table 13.6-1 of ASCE 7-16
    - d. Component Amplification Factor,  $a_p$ : See Table 13.6-1 of ASCE 7-16

### 2.02 ELASTOMERIC ISOLATION PADS

- A. Elastomeric Isolation Pads:
  - 1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
  - 2. Size: Factory or field cut to match requirements of supported equipment.
  - 3. Pad Material: Oil and water resistant with elastomeric properties.
  - 4. Surface Pattern: Smooth, Ribbed or Waffle pattern.
  - 5. Infused nonwoven cotton or synthetic fibers.
  - 6. Load-bearing metal plates adhered to pads.

### 2.03 ELASTOMERIC ISOLATION MOUNTS

- A. Double-Deflection, Elastomeric Isolation Mounts:
  - 1. Mounting Plates:
    - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
    - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
  - 2. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

### 2.04 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

- A. Restrained Elastomeric Isolation Mounts:
  - 1. Description: All-directional isolator with seismic restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
    - a. Housing: Cast-ductile iron or welded steel.

- b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

## 2.05 OPEN-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators:
  - 1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  - 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  - 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  - 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  - 5. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig (3447 kPa).
  - 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

## 2.06 HOUSED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing:
  - 1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  - 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  - 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  - 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  - 5. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
    - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
    - b. Top housing with attachment and leveling bolt.

## 2.07 RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:
  - 1. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
    - a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
    - b. Top plate with threaded mounting holes.
    - c. Internal leveling bolt that acts as blocking during installation.
  - 2. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
  - 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  - 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  - 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  - 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.08 HOUSED-RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing:
  - 1. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
    - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
    - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
  - 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.09 PIPE-RISER RESILIENT SUPPORT

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch- thick neoprene.
  - 1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
  - 2. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

2.10 RESILIENT PIPE GUIDES

- A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch- thick neoprene.
  - 1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.11 ELASTOMERIC HANGERS

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:
  - 1. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
  - 2. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.12 SPRING HANGERS

- A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

#### 2.13 SNUBBERS

- A. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
  1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
  2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
  3. Maximum 1/4-inch air gap, and minimum 1/4-inch- thick resilient cushion.

#### 2.14 RESTRAINT CHANNEL BRACINGS

- A. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

#### 2.15 RESTRAINT CABLES

- A. Restraint Cables: ASTM A 603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

#### 2.16 SEISMIC-RESTRAINT ACCESSORIES

- A. Hanger-Rod Stiffener: Reinforcing steel angle clamped to hanger rod.
- B. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- C. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- D. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

- E. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

## 2.17 EXECUTION

- A. components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

## 2.18 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 03 30 00 "Cast-in-Place Concrete." or Section 03 30 53 "Miscellaneous Cast-in-Place Concrete."
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.
- C. Comply with requirements in Section 07 72 00 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- D. Equipment Restraints:
  - 1. Install seismic snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
  - 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
  - 3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES that provides required submittals for component.
- E. Piping Restraints:
  - 1. Comply with requirements in MSS SP-127.
  - 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
  - 3. Brace a change of direction longer than 12 feet.
- F. Install cables so they do not bend across edges of adjacent equipment or building structure.
- G. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES that provides required submittals for component.
- H. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- I. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- J. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- K. Drilled-in Anchors:
  - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or

- drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
  3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
  4. Set anchors to manufacturer's recommended torque, using a torque wrench.
  5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

#### 2.19 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 22 11 16 "Domestic Water Piping" for piping flexible connections.

#### 2.20 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

END OF SECTION 22 05 48



## SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes:
  - 1. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Pipe labels.
  - 4. Valve Tags.

#### 1.02 ACTION SUBMITTALS

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

### PART 2 - PRODUCTS

#### 2.01 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
  - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
  - 2. Letter Color: White
  - 3. Background Color: Black
  - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
  - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  - 6. Minimum Letter Size: 1/4 inch For name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
  - 7. Fasteners: Stainless-steel rivets or self-tapping screws.
  - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- C. All labels on equipment visible to the public/occupant shall be coordinated with the architect or engineer prior to installation.

#### 2.02 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White

- C. Background Color: Red
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information plus emergency notification instructions.

## 2.03 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
  - 2. Lettering Size: At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

## 2.04 VALVE TAGS

- A. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme approved by Engineer. Provide 5/32-inch hole for fastener.
  - 1. Material: 0.032-inch thick brass or aluminum.
  - 2. Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
  - 1. Valve-tag schedule shall be included in operation and maintenance data.

## PART 3 - EXECUTION

### 3.01 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.

- B. Locate equipment labels where accessible and visible.

### 3.02 PIPE LABEL INSTALLATION

- A. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Near each valve and control device.
  - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Pipe Label Color Schedule:
  - 1. Compressed Air Piping:
    - a. Background: Blue
    - b. Letter Colors: White
  - 2. Domestic Water Piping:
    - a. Background: Green
    - b. Letter Colors: White
  - 3. Sanitary Waste and Storm Drainage Piping:
    - a. Background Color: Black
    - b. Letter Color: White

### 3.03 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
  - 1. Valve-Tag Size and Shape: 1-1/2 inches.
  - 2. Valve-Tag Color: Natural Brass or Aluminum.

### 3.04 VALVE-SCHEDULE INSTALLATION

- A. Mount valve schedule on wall in accessible location in each major equipment room.

### 3.05 CLEANING

- A. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION 22 05 53

## SECTION 22 07 16 - PLUMBING EQUIPMENT AND PIPING INSULATION

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section includes insulating requirements for equipment, piping:

#### 1.02 SUBMITTALS

- A. See section 22 00 00 "General Requirements of Plumbing" for submittal requirements.

#### 1.03 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

### PART 2 - PRODUCTS

#### 2.01 INSULATION MATERIALS

- A. Comply with requirements in "Equipment Insulation Schedule" "Piping Insulation Schedule," and "Duct Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Aeroflex USA, Inc.
    - b. Armacell LLC.

- c. K-Flex USA.
  - G. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
    - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. CertainTeed Corporation.
      - b. Johns Manville; a Berkshire Hathaway company.
      - c. Knauf Insulation.
      - d. Owens Corning.
  - H. Mineral-Fiber, Preformed Pipe Insulation:
    - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. Johns Manville; a Berkshire Hathaway company.
      - b. Knauf Insulation.
      - c. Owens Corning.
    - 2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - I. Thermal Insulating Wool:
    - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. Owens Corning
      - b. Prior Approved Equal
    - 2. Type I, 1000 Deg F Materials: Inorganic glass fibers bonded with thermosetting resin. Comply with ASTM C553, TIW Type I.
- 2.02 INSULATING CEMENTS
- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
- 2.03 ADHESIVES
- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
  - B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
  - C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
  - E. PVC Jacket Adhesive: Compatible with PVC jacket.

2.04 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
  - 1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
  - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  - 4. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
  - 1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
  - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 3. Solids Content: 60 percent by volume and 66 percent by weight.
  - 4. Color: White.

2.05 SEALANTS

- A. Metal Jacket Flashing Sealants:
  - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 2. Fire- and water-resistant, flexible, elastomeric sealant.
  - 3. Service Temperature Range: Minus 40 to plus 250 deg F.
  - 4. Color: Aluminum.
- B. ASJ Flashing Sealants, and PVC Jacket Flashing Sealants:
  - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 2. Fire- and water-resistant, flexible, elastomeric sealant.
  - 3. Service Temperature Range: Minus 40 to plus 250 deg F.
  - 4. Color: White.

2.06 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
  - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
  - 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.07 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. P.I.C. Plastics, Inc.
    - c. Proto Corporation.
    - d. Speedline Corporation.
  2. Adhesive: As recommended by jacket material manufacturer.
  3. Color: White.
  4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
    - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- C. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. ITW Insulation Systems; Illinois Tool Works, Inc.
    - c. RPR Products, Inc.
  2. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size.
  3. Finish and thickness are indicated in field-applied jacket schedules.
  4. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper or 2.5-mil-thick polysurlyn.
  5. Factory-Fabricated Fitting Covers:
    - a. Same material, finish, and thickness as jacket.
    - b. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
    - c. Tee covers.
    - d. Flange and union covers.
    - e. End caps.
    - f. Beveled collars.
    - g. Valve covers.
    - h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- D. Underground Direct-Buried Jacket: 125-mil-thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Pittsburgh Corning Corporation.
    - b. Polyguard Products, Inc.

## 2.08 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Width: 3 inches.
  2. Thickness: 11.5 mils.
  3. Adhesion: 90 ounces force/inch in width.
  4. Elongation: 2 percent.
  5. Tensile Strength: 40 lbf/inch in width.
  6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
  - 1. Width: 2 inches.
  - 2. Thickness: 6 mils.
  - 3. Adhesion: 64 ounces force/inch in width.
  - 4. Elongation: 500 percent.
  - 5. Tensile Strength: 18 lbf/inch in width.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
  - 1. Width: 2 inches.
  - 2. Thickness: 3.7 mils.
  - 3. Adhesion: 100 ounces force/inch in width.
  - 4. Elongation: 5 percent.
  - 5. Tensile Strength: 34 lbf/inch in width.

## 2.09 SECUREMENTS

- A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.
- B. Insulation Pins and Hangers:
  - 1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.
    - a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
    - b. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
    - c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
  - 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
    - a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed, stainless steel.

## 2.10 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

## 2.11 PROTECTIVE SHIELDING GUARDS



- A. Protective Shielding Pipe Covers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Plumberex Specialty Products, Inc.
    - b. Truebro.
    - c. Zurn Industries, LLC.
  - 2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
- B. Protective Shielding Piping Enclosures:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Truebro.
    - b. Zurn Industries, LLC.
  - 2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

### PART 3 - EXECUTION

#### 3.01 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

#### 3.02 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item as specified in insulation schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
  - 1. Vibration-control devices.
  - 2. Testing agency labels and stamps.
  - 3. Nameplates and data plates.
  - 4. Manholes.
  - 5. Handholes.
  - 6. Cleanouts.
- Q. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

### 3.03 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
  - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
  - 1. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
  - 1. Pipe: Install insulation continuously through floor penetrations.
  - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."
  - 3. end joints.
  - 4. Protect exposed corners with secured corner angles.
  - 5. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
    - a. Do not weld anchor pins to ASME-labeled pressure vessels.
    - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
    - d. Do not over compress insulation during installation.
    - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    - f. Impale insulation over anchor pins and attach speed washers.
    - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

6. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
7. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch pre-stressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch pre-stressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
8. Stagger joints between insulation layers at least 3 inches.
9. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
10. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
11. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

#### 3.04 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
  1. Install pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
  4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
  1. Install mitered sections of pipe insulation.
  2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

#### 3.05 INSTALLATION OF MINERAL-FIBER PREFORMED PIPE INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
  1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
  2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
  3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.

4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
  4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Fittings, Joints and Couplings:
1. All piping fittings shall be insulated by filling the total void over all fittings between straight runs of pipe insulation with thermal insulating wool, forming a uniform insulation thickness equal to, or exceeding, the adjacent pipe insulation.
  2. Finish all insulated pipe fittings by applying PVC fitting covers overlapping the adjacent pipe insulation outer covering.
  3. For hot service piping (105F and above), secure the PVC fitting covers stainless steel tack fasteners.
  4. For cold service piping (60F and below), seal the ends of the adjacent pipe insulation with vapor barrier mastic, ensure that the PVC fitting cover overlaps the adjacent pipe insulation jacket by 2" minimum and secure PVC fitting covers to adjacent pipe insulation with 2" wide PVC Tape.
  5. Fitting covers for grooved piping systems shall be the type specifically manufactured for grooved piping systems.

### 3.06 INSULATION INSTALLATION ON VALVES AND PIPE SPECIALTIES

- A. Install removable insulation covers on all valves and specialties 1-1/2" and larger.
1. Valves, Strainers, and Unions 1-1/2 – 2 NPS: "No Sweat" re-usable valve covers or approved equal product.
  2. Valves, Strainers and Unions 2-1/2" and larger use removable insulation jackets from Thermaxx or prior approved manufacturer.

### 3.07 FIELD-APPLIED JACKET INSTALLATION

- A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.
- C. Where underground direct-buried jacket are indicated, install per the manufacturers instructions.

### 3.08 FINISHES

- A. Insulation with ASJ or Other Paintable Jacket Material and where Required: Paint jacket with paint system identified below and as specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
  - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Do not field paint aluminum or PVC jacketing.

### 3.09 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 3.10 PIPING INSULATION SCHEDULE

- A. Insulation materials and thicknesses for Plumbing piping are identified in the table below. If more than one material is listed for an application, selection from materials listed is at the Contractor's option.

Application	Nominal Pipe Size	Insulation Type	Insulation Conductivity (Btu x in) / (hr x ft <sup>2</sup> x F)	Insulation Thickness (in)	Vapor Barrier	Factory Installed Jacket Type
Domestic Cold Water Piping	All	Glass Fiber or Flexible Elastomeric	0.27	1	Yes	ASJ
Domestic Hot Water and Recirc.	½ - 1-1/4 NPS	Glass Fiber or Flexible Elastomeric	0.27	1	No	ASJ
Domestic Hot Water and Recirc.	1-1/2 – 12 NPS	Glass Fiber or Flexible Elastomeric	0.27	1.5	No	ASJ
Plumbing Vents within 6ft of roof termination	All	Glass Fiber or Flexible Elastomeric	0.27	1	Yes	ASJ

3.11 FIELD APPLIED JACKETING SCHEDULE

- A. Field applied jackets for Plumbing piping are identified in the table below. If more than one material is listed for an application, selection from materials listed is at the Contractor's option.

Application	Installation Location	Field Applied Jacketing
Domestic Water Piping	Indoors	PVC when piping is exposed and within 7ft of the floor.
Domestic Water Piping	Outdoors	Aluminum Jacket

END OF SECTION 22 07 16

## SECTION 22 11 16 - DOMESTIC WATER PIPING

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes:
  - 1. Copper tube and fittings.
  - 2. PEX tube and fittings.
  - 3. Piping joining materials.
  - 4. Transition fittings.
- B. Related Requirements:
  - 1. Section 22 05 00 "General Provisions of Plumbing"

#### 1.02 ACTION SUBMITTALS

- A. See Section 22 00 00 "General Requirements of Plumbing" for submittal requirements.

### PART 2 - PRODUCTS

#### 2.01 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14 and NSF 61 Annex G. and Plastic piping components shall be marked with "NSF-pw."
- C. Comply with NSF Standard 372 for low lead.

#### 2.02 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
- B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- E. Copper Unions:
  - 1. MSS SP-123.
  - 2. Cast-copper-alloy, hexagonal-stock body.
  - 3. Ball-and-socket, metal-to-metal seating surfaces.
  - 4. Solder-joint or threaded ends.
- F. Copper Pressure-Seal-Joint Fittings:
  - 1. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.



2. Fittings for NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

#### 2.03 PEX TUBE AND FITTINGS

- A. Tube Material: PEX plastic according to ASTM F 876 and ASTM F 877.
- B. Fittings: ASTM F 1960, cold expansion fittings and reinforcing rings.
- C. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F 876; with plastic or corrosion-resistant-metal valve for each outlet.
- D. Trays: Galvanized steel support trays.

#### 2.04 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials:
  1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
  2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys.
- D. Flux: ASTM B 813, water flushable.
- E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

#### 2.05 TRANSITION FITTINGS

- A. General Requirements:
  1. Same size as pipes to be joined.
  2. Pressure rating at least equal to pipes to be joined.
  3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

### PART 3 - EXECUTION

#### 3.01 EARTHWORK

- A. Comply with requirements in Section 31 20 00 "Earth Moving" for excavating, trenching, and backfilling.

#### 3.02 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and

calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 22 05 19 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 22 11 19 "Domestic Water Piping Specialties."
- D. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 22 11 19 "Domestic Water Piping Specialties."
- E. Install domestic water piping level and plumb.
- F. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- G. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- H. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- I. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- J. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- K. Install piping to permit valve servicing.
- L. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- M. Install piping free of sags and bends.
- N. Install fittings for changes in direction and branch connections.
- O. Install PEX tubing with loop at each change of direction of more than 90 degrees.
- P. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- Q. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 22 05 19 "Meters and Gages for Plumbing Piping."
- R. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 22 05 19 "Meters and Gages for Plumbing Piping."
- S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 00 "General Provisions of Plumbing."
- T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 00 "General Provisions of Plumbing."

- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 22 05 00 "General Provisions of Plumbing."

### 3.03 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Joints for PEX Tubing: Join according to ASTM F 1960 for cold expansion fittings and reinforcing rings.
- H. Joints for PEX Tubing: Join according to ASSE 1061 for push-fit fittings.
- I. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

### 3.04 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
  - 1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
  - 2. Fittings for NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

### 3.05 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger, support products, and installation in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
  - 1. Vertical Piping: MSS Type 8 or 42, clamps.

2. Individual, Straight, Horizontal Piping Runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
  3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
  2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
  3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
  4. NPS 2-1/2: 108 inches with 1/2-inch rod.
  5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
  6. NPS 6: 10 feet with 5/8-inch rod.
  7. NPS 8: 10 feet with 3/4-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.
- G. Install vinyl-coated hangers for PEX tubing with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1 and Smaller: 32 inches with 3/8-inch rod.
- H. Install hangers for vertical PEX tubing every 48 inches.
- I. PEX tubing shall be supported between hangers with the tubing manufacturer's tubing tray.
- J. Support piping and tubing not listed in this article according to MSS SP-58 and manufacturer's written instructions.

### 3.06 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
  1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
  2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
  3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
  4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.07 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 22 05 53 "Identification for Plumbing Piping and Equipment."
- B. Label pressure piping with system operating pressure.

3.08 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Piping Inspections:
    - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
    - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
      - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
      - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
    - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
    - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
  - 2. Piping Tests:
    - a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
    - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
    - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
    - d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
    - e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
    - f. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.09 ADJUSTING

- A. Perform the following adjustments before operation:
  - 1. Close drain valves, hydrants, and hose bibbs.
  - 2. Open shutoff valves to fully open position.
  - 3. Open throttling valves to proper setting.

4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
  - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
  - b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

### 3.10 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
  1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Fill and isolate system according to either of the following:
      - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
      - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
    - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    - d. Repeat procedures if biological examination shows contamination.
    - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

### 3.11 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.


END OF SECTION 22 11 16

## SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes:
  - 1. Vacuum breakers.
  - 2. Backflow preventers.
  - 3. Water pressure-reducing valves.
  - 4. Temperature-actuated, water mixing valves.
  - 5. Digital Water Temperature Control Valve.
  - 6. Bronze, Calibrated-Orifice, Balancing Valves.
  - 7. Strainers.
  - 8. Drain valves.
  - 9. Water-hammer arresters.
  - 10. Trap-seal primer valves.
- B. Related Requirements:
  - 1. Section 22 05 00 "General Provisions of Plumbing" for Expansion Loops, Alignment Guides, Dielectric Fittings, Sleeves and Sleeve Seals, Sealants, Escutcheons and floor plates.
  - 2. Section 22 05 19 "Meters and Gages for Plumbing Piping" for thermometers, pressure gages.
  - 3. Section 22 11 16 "Domestic Water Piping" for piping and fittings.

#### 1.02 ACTION SUBMITTALS

- A. See Section 22 00 00 "General Requirements of Plumbing" for submittal requirements.

### PART 2 - PRODUCTS

#### 2.01 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Potable-water piping and components shall comply with NSF 61 Annex G and NSF 14. Mark "NSF-pw" on plastic piping components.

#### 2.02 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

#### 2.03 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
  - 1. Standard: ASSE 1001.

2. Size: NPS 1/4 to NPS 3, as required to match connected piping.
3. Body: Bronze.
4. Inlet and Outlet Connections: Threaded.
5. Finish: Chrome plated.

B. Hose-Connection Vacuum Breakers:

1. Standard: ASSE 1011.
2. Body: Bronze, nonremovable, with manual drain.
3. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
4. Finish: Chrome or nickel plated.

2.04 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Leonard Valve Company.
  - b. Symmons Industries, Inc.
  - c. Watts; a Watts Water Technologies company.
  - d. Zurn Industries, LLC.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Valve Finish: Chrome plated.

B. Primary, Thermostatic, Water Mixing Valves:

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 International, Inc.
  - b. Leonard Valve Company.
  - c. Symmons Industries, Inc.
  - d. Zurn Industries, LLC.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Type: Cabinet-type, thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Valve Finish: Chrome plated.
9. Piping Finish: Chrome plated.
10. Cabinet: Factory fabricated, stainless steel, for surface mounting and with hinged, stainless-steel door.



2.05 DIGITAL, WATER TEMPERATURE CONTROL VALVE

1. Manufacturers:
  - a. "The Brain" by Armstrong International
  - b. Prior approved equal
2. Description: Water temperature control valve with integral digital controls and pre-piped re-circulation manifold
3. Precision: +/- 2 Deg F Temperature Control
4. Communication: Serial Connections for BMS interface (BACnet).
5. Valve Construction: Stainless Steel
6. Electrical: 120 – 240 V single phase
7. Max Inlet Temperature: 185 Deg F
8. Operating Pressure: 10 – 150 psig.
9. Minimum re-circulation flow: 5 gpm
10. ASSE 1017, CSA B125 and CE Certified
11. Auto shutoff on loss of cold-water flow or power failure.
12. High and Low temp alarms.

2.06 BRONZE, CALIBRATED-ORIFICE, BALANCING VALVES

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Bell & Gossett; a Xylem brand.
  - b. Flow Design, Inc.
  - c. Nexus Valve, Inc.
  - d. TACO Comfort Solutions, Inc.
2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Plug: Resin.
5. Seat: PTFE.
6. End Connections: Threaded or socket.
7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
8. Handle Style: Lever, with memory stop to retain set position.
9. CWP Rating: Minimum 125 psig.
10. Maximum Operating Temperature: 250 deg F.

2.07 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:
  - a. Strainers NPS 2 and Smaller: 0.020 inch.
  - b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
6. Drain: Factory-installed, hose-end drain valve with cap.

2.08 DRAIN VALVES

- A. Ball-Valve-Type, Hose-End Drain Valves:
1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
  2. Pressure Rating: 400-psig minimum CWP.
  3. Size: NPS 3/4.
  4. Body: Copper alloy.
  5. Ball: Chrome-plated brass.
  6. Seats and Seals: Replaceable.
  7. Handle: Vinyl-covered steel.
  8. Inlet: Threaded or solder joint.
  9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.09 WATER-HAMMER ARRESTERS

- A. Water-Hammer Arresters:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Jay R. Smith Mfg. Co.
    - b. Sioux Chief Manufacturing Company, Inc.
    - c. Watts; a Watts Water Technologies company.
    - d. Zurn Industries, LLC.
  2. Standard: ASSE 1010 or PDI-WH 201.
  3. Type: Metal bellows or Copper tube with piston.
  4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.10 TRAP-SEAL PRIMER DEVICE

- A. Supply-Type, Trap-Seal Primer Device:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Jay R. Smith Mfg. Co.
    - b. Sioux Chief Manufacturing Company, Inc.
    - c. Watts; a Watts Water Technologies company.
    - d. Zurn Industries, LLC.
  2. Standard: ASSE 1018.
  3. Pressure Rating: 125 psig minimum.
  4. Body: Bronze.
  5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
  6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
  7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

- A. Install double check backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
  - 1. Locate backflow preventers in same room as connected equipment or system.
  - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
  - 3. Do not install bypass piping around backflow preventers.
- B. Install water regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- C. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
  - 1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- D. Install balancing valves at each hot water recirculation branch connection to the return main.
- E. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve, solenoid valve and pump.
- F. Install water-hammer arresters in water piping according to PDI-WH 201.
- G. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

#### 3.02 CONNECTIONS

- A. Comply with requirements for ground equipment in Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- B. Fire-retardant-treated-wood blocking is specified in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

#### 3.03 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Test each reduced-pressure-principle backflow preventer and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.
- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.04 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves. Verify pressure set points with Engineer prior to setting
- B. Set field-adjustable flow set points of balancing valves. Verify flow rates with Engineer prior to setting.
- C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves. Verify temperature setting with engineer prior to setting.

END OF SECTION 22 11 19

## SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes:
  - 1. Pipe, tube, and fittings.
  - 2. Specialty pipe fittings.

#### 1.02 ACTION SUBMITTALS

- A. See section 22 00 00 "General Requirements of Plumbing" for submittal requirements.

### PART 2 - PRODUCTS

#### 2.01 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
  - 1. Soil, Waste, and Vent Piping: 10-foot head of water.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. See section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment"

#### 2.02 PIPING MATERIALS

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

#### 2.03 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
  - 1. Standards: ASTM C 1277 and CISPI 310.
  - 2. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

#### 2.04 COPPER TUBE AND FITTINGS

- A. Copper Type DWV Tube: ASTM B 306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

- C. Copper Pressure Fittings:
  - 1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
  - 2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- D. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
  - 1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
  - 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- E. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

## 2.05 PVC PIPE AND FITTINGS

- A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.
- B. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- D. Adhesive Primer: ASTM F 656.
- E. Solvent Cement: ASTM D 2564.

## 2.06 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
  - 1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
  - 2. Unshielded, Non-pressure Transition Couplings:
    - a. Standard: ASTM C 1173.
    - b. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
    - c. End Connections: Same size as and compatible with pipes to be joined.
    - d. Sleeve Materials:
      - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
      - 2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
      - 3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
  - 3. Shielded, Non-pressure Transition Couplings:
    - a. Standard: ASTM C 1460.
    - b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
    - c. End Connections: Same size as and compatible with pipes to be joined.

### PART 3 - EXECUTION

#### 3.01 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 31 20 00 "Earth Moving."

#### 3.02 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
  - 1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
  - 2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
  - 1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
  - 2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
    - a. Straight tees, elbows, and crosses may be used on vent lines.
  - 3. Do not change direction of flow more than 90 degrees.
  - 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
    - a. Reducing size of waste piping in direction of flow is prohibited.
- L. Lay buried building waste piping beginning at low point of each system.
  - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.

2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
  3. Maintain swab in piping and pull past each joint as completed.
- M. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
1. Horizontal Sanitary Waste: 1/4" per foot downward in direction of flow. 1/8" per foot is allowable if necessitated by site conditions.
  2. Vent Piping: 1/8" per foot down toward vertical fixture vent or toward vent stack.
- N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- O. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- P. Install aboveground PVC piping according to ASTM D 2665.
- Q. Install underground PVC piping according to ASTM D 2321.
- R. Plumbing Specialties:
1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
    - a. Comply with requirements for cleanouts specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
- S. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- T. Install sleeves for piping penetrations of walls, ceilings, and floors.
1. Comply with requirements for sleeves specified in Section 22 05 00 "General Provisions of Plumbing."
- U. Install sleeve seals for piping penetrations of concrete walls and slabs.
1. Comply with requirements for sleeves specified in Section 22 05 00 "General Provisions of Plumbing."
- V. Install escutcheons for piping penetrations of walls, ceilings, and floors.
1. Comply with requirements for escutcheons specified in Section 22 05 00 "General Provisions of Plumbing."
- 3.03 JOINT CONSTRUCTION
- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- C. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- D. Plastic, Non-pressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:



1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 appendixes.
3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 appendixes.

### 3.04 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
1. Install transition couplings at joints of piping with small differences in ODs.
  2. In Waste Drainage Piping: [**Unshielded**] [**Shielded**], nonpressure transition couplings.

### 3.05 VALVE INSTALLATION

- A. Comply with requirements in Section 22 05 23.12 "Ball Valves for Plumbing Piping," Section 22 05 23.13 "Butterfly Valves for Plumbing Piping," Section 22 05 23.14 "Check Valves for Plumbing Piping," and Section 22 05 23.15 "Gate Valves for Plumbing Piping" for general-duty valve installation requirements.
- B. Shutoff Valves:
1. Install shutoff valve on each sewage pump discharge.
  2. Install gate or full-port ball valve for piping NPS 2 and smaller.
  3. Install gate valve for piping NPS 2-1/2 and larger.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

### 3.06 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Section 22 05 48 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
1. Vertical Piping: MSS Type 8 or Type 42, clamps.
  2. Install individual, straight, horizontal piping runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
  3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
  2. NPS 3: 60 inches with 1/2-inch rod.

3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
  4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
  5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
  6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4: 72 inches with 3/8-inch rod.
  2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
  3. NPS 2-1/2: 108 inches with 1/2-inch rod.
  4. NPS 3 and NPS 5: 10 feet with 1/2-inch rod.
  5. NPS 6: 10 feet with 5/8-inch rod.
  6. NPS 8: 10 feet with 3/4-inch rod.
- I. Install supports for vertical copper tubing every 10 feet.
- J. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
  2. NPS 3: 48 inches with 1/2-inch rod.
  3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
  4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
  5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.
- K. Install supports for vertical PVC piping every 48 inches.
- L. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

### 3.07 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect waste and vent piping to the following:
1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
  2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
  3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
  4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
  5. Equipment: Connect waste piping as indicated.
    - a. Provide shutoff valve if indicated and union for each connection.
    - b. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

- E. Make connections according to the following unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

### 3.08 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping.
- B. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

### 3.09 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
    - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
    - a. Expose work that was covered or concealed before it was tested.
  - 3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
    - a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
    - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
    - c. Inspect joints for leaks.
  - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
    - a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
    - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
    - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
    - d. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.10 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.
- E. Repair damage to adjacent materials caused by waste and vent piping installation.

3.11 PIPING SCHEDULE

- A. Piping system materials are identified in the table below. If more than one material is listed, selection from the materials listed is at the Contractor's option.

Application	Location	Size	Material	Fittings
Sanitary Waste and Vent	Below Grade	All	PVC	Solvent Joint
Sanitary Waste and Vent	Above Grade	All	PVC	No-Hub
Domestic Hot & Cold	Above Grade	All	'L' Copper or PEX	Braze/Solder or Press Fittings
Trap Primer Connections	Below Grade	All	PEX	Press Fittings

END OF SECTION 22 13 16

## SECTION 22 13 19 - SANITARY WASTE PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes:
  - 1. Cleanouts.
  - 2. Miscellaneous sanitary drainage piping specialties.
- B. Related Requirements:
  - 1. Section 22 13 16 "Sanitary Waste and Vent Piping"

#### 1.02 SUBMITTALS

- A. See Section 22 00 00 "General Requirements of Plumbing" for submittal requirements.

### PART 2 - PRODUCTS

#### 2.01 ASSEMBLY DESCRIPTIONS

- A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

#### 2.02 CLEANOUTS

- A. Above Grade Wall Cleanout
  - 1. Provide JR Smith 4422 or approved equal
  - 2. Description: Cast iron caulked spigot ferrule with cast bronze taper thread plug and stainless-steel round cover and screw.
- B. Finished Floor Cleanout
  - 1. Provide JR Smith 4100 or approved equal
  - 2. Description: Cast iron cleanout with extra heavy-duty round, adjustable, scoriated, secured nickel bronze top, and no-hub outlet, gasket seal bronze plug and flashing clamp for.

#### 2.03 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

- A. Open Drains or Hub Drains:
  - 1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-less, cast-iron soil-pipe fittings. Include P-trap, riser section; and where required, increaser fitting joined with ASTM C 564 rubber gaskets.
  - 2. Size: See drawings. If not shown drain shall 2" minimum or one size larger than piping discharging to the drain.

- B. Floor-Drain, Trap-Seal Primer Fittings:
  - 1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
  - 2. Size: Same as floor drain outlet with NPS 1/2 side inlet.
- C. Floor-Drain, Trap Seal:
  - 1. Barrier type floor drain or sink trap seal device.
  - 2. IAPMO 7479 and ASSE std. 1072 listed.
- D. Expansion Joints:
  - 1. Standard: ASME A112.6.4.
  - 2. Body: Cast iron with bronze sleeve, packing, and gland.
  - 3. End Connections: Matching connected piping.
  - 4. Size: Same as connected soil, waste, or vent piping.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

- A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
  - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
  - 2. Locate at each change in direction of piping greater than 45 degrees.
  - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
  - 4. Locate at base of each vertical soil and waste stack.
- B. For floor cleanouts for piping below floors, install cleanout with top flush with finished floor. It shall be the responsibility of the plumbing contractor to coordinate the installation of cleanouts with the general contractor and floor contractor to ensure that floor cleanouts are properly adjusted so that the top is flush and level with finished flooring material. Cleanout covers that are not flush and level with the finished floor will be rejected and the plumbing contractor will be required to sawcut or core drill the floor, provide and install and new cleanout, coordination installation of new concrete and new finished flooring material.
- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. Coordinate installation of roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof with the general contractor or construction manager.
- E. Assemble open drain fittings and install with top of hub 2 inches above floor.
- F. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- G. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
  - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
  - 2. Size: Same as floor drain inlet.
- H. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

- I. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- J. Install wood-blocking reinforcement for wall-mounting-type specialties.
- K. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.02 CONNECTIONS

- A. Comply with requirements in Section 22 13 16 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.03 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 13 19

## SECTION 22 41 00 - PLUMBING FIXTURES

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes:
  - 1. Plumbing fixtures shown and scheduled on the drawings.

#### 1.02 SUBMITTALS

- A. See section 22 00 00 "General Requirements of Plumbing" for submittal requirements.

### PART 2 - PRODUCTS

#### 2.01 PLUMBING FIXTURE MANUFACTURERS

- A. FLOOR DRAINS & SINKS
  - 1. Fixtures
    - a. Jr Smith
    - b. Zurn
    - c. Josam
  - 2. Trap Seal
    - a. Trap Guard
    - b. Jr Smith
  - 3. Trap Primers
    - a. Jr Smith
    - b. Watts
    - c. Zurn
    - d. Sioux Chief
- B. LAVATORIES
  - 1. Fixtures
    - a. Kohler
    - b. American Standard
    - c. Toto
  - 2. Carriers And Supports
    - a. Jr Smith
    - b. Zurn
    - c. Josam
  - 3. Faucets
    - a. Moen Commercial
    - b. Sloan
    - c. Chicago Faucets
  - 4. Piping Covers
    - a. Trubro
    - b. Plummerex



- C. STOP VALVES
  - 1. Brasscraft
  - 2. Watts
  - 3. Kingston Brass
- D. THERMOSTATIC MIXING VALVES
  - 1. Symmons
  - 2. Watts
  - 3. Leonard
- E. URINALS
  - 1. Fixtures
    - a. Kohler
    - b. American Standard
    - c. Toto
    - d. Sloan
  - 2. Flush Valves
    - a. Moen
    - b. Zurn
    - c. Sloan
  - 3. Carriers and Supports
    - a. Jr Smith
    - b. Zurn
    - c. Josam
- F. WATER CLOSETS
  - 1. Fixtures
    - a. Kohler
    - b. American Standard
    - c. Toto
    - d. Sloan
  - 2. Flush Valves
    - a. Moen
    - b. Zurn
    - c. Sloan
  - 3. Seats
    - a. Kohler
    - b. Church
    - c. Olsonite
  - 4. Carriers and Supports
    - a. Jr Smith
    - b. Zurn
    - c. Josam

2.02 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.

- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

- A. Install plumbing fixtures level and plumb according to roughing-in drawings.
- B. Install floor-mounted water closets on closet flange attachments to drainage piping.
- C. Install counter-mounting fixtures in and attached to casework.
- D. Install pedestal lavatories on pedestals and secured to wood blocking in wall.
- E. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
  - 1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Comply with valve requirements specified in Section 22 05 23 "General-Duty Valves for Plumbing Piping."
- F. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- G. Install toilet seats on water closets.
- H. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- I. Install traps on fixture outlets.
  - 1. Exception: Omit trap on fixtures with integral traps.
  - 2. Exception: Omit trap on indirect wastes unless otherwise indicated.
- J. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories and sinks.
- K. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings.
- L. Seal joints between plumbing fixtures, counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.

#### 3.02 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 22 11 16 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

- D. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories and sinks.
- E. All electrical connections shall be coordinated by the plumbing contractor with the electrical contractor.

3.03 ADJUSTING

- A. Operate and adjust plumbing fixtures and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.

3.04 CLEANING AND PROTECTION

- A. After completing installation of plumbing fixtures, inspect and repair damaged finishes.
- B. Clean plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed plumbing fixtures and fittings.
- D. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 41 00

SECTION 23 00 00 - GENERAL REQUIREMENTS OF HVAC

PART 1 - GENERAL

1.01 SUMMARY

- A. The requirements listed in this section are supplemental to the Division 01 General Requirements.
- B. It shall be the responsibility of the Mechanical Contractor to examine and refer to all Architectural, Civil, Structural, Plumbing, Electrical, and Landscape plans and specifications for construction conditions which may affect the scope of HVAC work. Inspect the building site and existing facilities for verification of present conditions. Make proper provisions for these conditions in performance of the work and cost thereof.
- C. Mechanical work for this project shall include all items, articles, materials and the associated labor mentioned, scheduled or shown in these specifications and in the accompanying drawings.
- D. Furnish and install all equipment, materials and any required incidental items required by good practice to complete the systems described herein.

1.02 CODES AND STANDARDS

- A. Work shall meet the requirements of the plans and specifications and shall not be less than the minimum requirements of applicable sections of the latest Codes and Standards of the following Organizations:
  - 1. American Gas Association (AGA)
  - 2. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
  - 3. American Society of Mechanical Engineers (ASME)
  - 4. Sheet Metal and Air Conditioning Contractors' National Association Inc. (SMACNA)
  - 5. American Water Works Association (AWWA)
  - 6. Oregon Electrical Specialty Code (OESC)
  - 7. National Electrical Manufacturers Association (NEMA)
  - 8. National Fire Protection Association (NFPA)
  - 9. Oregon Plumbing Specialty Code (OPSC)
  - 10. Occupational Safety & Health Act (OSHA)
  - 11. Plastic Pipe Institute (PPI)
  - 12. Oregon Mechanical Specialty Code (OMSC)
  - 13. Oregon Mechanical Specialty Code Appendix C (OMSC APPENDIX C)
  - 14. Oregon Structural Specialty Code (OSSC)
  - 15. Oregon Energy Efficiency Specialty Code (OEESC)
  - 16. Requirements of the Serving Utility Company
  - 17. Local and State Codes and Ordinances

1.03 FEES AND PERMITS

- A. The Mechanical Contractor shall pay all fees and arrange all permits required for work done under their contract and under their supervision by subcontract.

- B. All usage contracts between the Owner and the serving utilities company, such as membership and usage charges or fees, etc., for the purpose of obtaining the services for the utility company shall be applied for and paid for by the Owner.

#### 1.04 MATERIALS AND EQUIPMENT

- A. Manufacturer's trade names and catalog numbers listed are intended to indicate the quality of equipment or materials desired. Manufacturers not listed in the specification will be considered substitutions and must have prior approval.
- B. See Division 01 for Substitutions Procedures. Requests for substitution are to be submitted sufficiently ahead of the deadline, to give ample time for examination. Prior approval request for substitution must indicate the specific item or items to be furnished in lieu of those scheduled, together with complete technical and comparative data on scheduled items and items proposed for substitution.
- C. If the engineer approves any proposed substitution, the approved product will be listed in an addendum. Bidders shall not rely on approval made in any other manner.
- D. Mechanical equipment may be installed with manufacturer's standard finish and color except where specific color, finish or choice is indicated. If the manufacturer has no standard finish, equipment shall have a prime coat and two finish coats of gray enamel.
- E. High altitude operation: Capacity of all equipment is to be sized and manufactured to perform at the elevation of the project site. If not specifically indicated in the equipment schedule or in the specifications provide all required accessories and equipment for proper operation at elevation of the project site.
- F. This Contractor shall be responsible for materials and equipment installed under this contract. Contractor shall also be responsible for the protection of materials and equipment of others from damage as a result of his work.
- G. Manufactured material and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by manufacturer unless herein specified to the contrary.
- H. This Contractor shall make the required arrangement with the General Contractor or Construction Manager for the introduction into the building of equipment too large to pass through finished openings.
- I. Store materials and equipment indoors at the job site. If this is not possible, store on raised platforms and protect from the weather by means of waterproof covers. Coverings shall permit circulation of air around the materials to prevent condensation of moisture. Screen or cap openings in equipment to prevent the entry of vermin.

#### 1.05 INTENT OF DRAWINGS

- A. The drawings are diagrammatic and do not necessarily show exact location of piping and ductwork unless specifically dimensioned. Riser and other diagrams are schematic and do not necessarily show the physical arrangement of the equipment. They shall not be used for obtaining lineal runs of piping or ductwork, nor shall they be used for shop drawings for piping and ductwork fabrication or ordering. Discrepancies shown on different plans, or between plans and actual field conditions shall be brought to the attention of the Architect/Engineer for resolution.

1.06 COMMISSIONING OF SYSTEMS

- A. Mechanical systems with a total cooling capacity exceeding 480,000 Btu/hr or a combined heating and service water-heating capacity exceeding 600,000 Btu/hr shall be commissioned by a registered professional in accordance with Section C408 of the Oregon Energy Efficiency Specialty Code. The mechanical contractor shall correct all installation deficiencies identified by the commissioning agent at no cost to the owner.
- B. See Sections 019113 "Commissioning Requirements of Contractor", 220800 "Commissioning of Plumbing", 230800 "Commissioning of HVAC", 260800 "Commissioning of Electrical Systems".

1.07 RESPONSIBILITY

- A. HVAC work shall conform to requirements of all divisions 22 and 23 specifications.
- B. The Mechanical Contractor shall be responsible for the installation of a satisfactory and complete system in accordance with the intent of the drawing and specifications. Provide, at no extra cost, all incidental items, materials, accessories and labor required for completion of the work even though they are not specifically mentioned or indicated on the drawings or in the specifications.
- C. The drawings do not attempt to show complete details of the building construction which affect the mechanical installation; and reference is therefore required to the Architectural, Civil, Structural, Landscape and Electrical drawings and specifications and to shop drawings of all trades for additional details which affect the installation of the work covered under this Division of the Contract.
- D. Location of mechanical system components shall be checked for conflicts with openings, structural members and components of other systems having fixed locations. In the event of any conflicts, the Architect/Engineer shall be consulted, and their decision shall govern. Necessary changes shall be made at the Contractor's expense.
- E. Determine, and be responsible for, the proper location and character of inserts for hangers, chases, sleeves, and other openings in the construction required for the work and obtain this information well in advance of the construction progress so work will not be delayed.
- F. Final location of inserts, hangers, etc., required for each installation, must be coordinated with facilities required for other installations to prevent interference.
- G. Take extreme caution not to install work that connects to equipment until such time as complete Shop Drawings of such equipment have been approved by the Architect/Engineer. Any work installed by the Contractor, prior to approval of Shop Drawings, will be at the Contractor's risk.
- H. All modifications and changes required due to installation of equipment other than the scheduled equipment shall be made at the contractor's expense.
- I. It shall be the responsibility of the installing contractor to coordinate changes to work by other trades that result from the installation of equipment other than the scheduled equipment.
- J. If the provided equipment is heavier or larger than the scheduled or specified equipment, it shall be the responsibility of the installing contractor to coordinate the required structural changes and pay for any and all associated cost.

- K. If the provided equipment has different motor characteristics or electrical requirements than the scheduled or specified equipment, it shall be the responsibility of the installing contractor to coordinate the required changes and pay for any and all associated cost.
- L. If larger or additional electrical conduits, wire or breakers are required due to the installation of equipment other than the scheduled or specified equipment it shall be the responsibility of the installing contractor to coordinate the required changes and pay for any and all associated cost.
- M. If the provided equipment requires different fluid flow rates than the scheduled or specified equipment, it shall be the responsibility of the installing contractor to coordinate all required changes including but not limited to pumps, piping, valves, etc and pay for any and all associated cost.
- N. At all times during the performance of this Contract, properly protect work from damage and protect the Owner's property from injury or loss. Make good any damage, injury or loss, except such as may be directly due to errors in the Bidding Documents or caused by Agents or Employees of the Owner. Adequately protect adjacent property as provided by law and the Bidding Documents. Provide and maintain passageways, guard fences, lights and other facilities for protection required by Public Authority or Local conditions.
- O. The Contractor shall be responsible for damages incurred due to the work of their contractors, to the building or its contents, people, etc.

1.08 REVIEW

- A. All work and material is subject to review at any time by the Architect/Engineer or his representative. If the Architect/Engineer or his representative finds material that does not conform to these specifications or that is not properly installed or finished, correct the deficiencies in a manner satisfactory to the Architect/Engineer at the Contractor's expense.

1.09 WORKMANSHIP

- A. Work under this contract shall be performed by workmen skilled in the particular trade, including work necessary to properly complete the installation in a workmanlike manner to present a neat and finished appearance.
- B. Obtain Architect's/Engineer's approval before performing any cutting on structural members or patching of building surfaces. Any damage to the building or equipment by the Mechanical Contractor shall be the responsibility of the Mechanical Contractor and shall be repaired by skilled craftsmen of the trades involved at the Contractor's expense.
- C. Chases, openings, sleeves, hangers, anchors, recesses, equipment pads, and framing for equipment; shall be provided by others only if so noted on the drawings. Otherwise, they will be provided by the Mechanical Contractor for their work.

1.10 COORDINATION

- A. The Mechanical Contractor shall plan their work to proceed with a minimum interference with other trades and it shall be their responsibility to inform the General Contractor of all openings required in the building structure for installation of work, and to provide sleeves as required. Dimensions of equipment installed and/or provided by others shall be checked so that correct clearances and connections may be made.

- B. In general, pipelines requiring gravity drainage shall be installed first, followed by ductwork, large piping mains and electrical conduit. The location of fire protection piping and heads shall be coordinated with other trades to ensure that installations by other trades do not block heads.
- C. Leave sufficient space for the installation of insulation on piping and ductwork as specified. It is not acceptable to compress pipe or duct insulation for any reason.

#### 1.11 CLEANING

- A. Keep the job site clean. The Mechanical Contractor shall remove all waste and rubbish associated with their work.
- B. Upon completion of work, remove materials, scraps and debris related to mechanical work and leave all spaces including tunnels, crawlspaces, pipe or duct chases and ceiling plenums clean and orderly.
- C. The Mechanical contractor will be responsible for cleaning the exterior and interior of all equipment prior to start-up. Once all equipment has been cleaned it shall be inspected by the Architect/Engineer prior to start-up.
- D. The Mechanical Contractor shall provide dust protection of existing materials and equipment as well a new materials and equipment for the duration of the project. Protect existing materials and equipment from damage for the duration of the project. Clean the exterior and interior of all existing equipment at the completion of the project.

#### 1.12 TEMPORARY FACILITIES

- A. Offices
  - 1. The Mechanical Contractor must have the permission of the Owner and General Contractor or Construction Manager to install a temporary office/job trailer on the project site.
  - 2. The Contractor shall completely remove his temporary installations when no longer needed and the premises shall be completely clean, disinfected, patched, and refinished to match adjacent areas.
- B. Ladders and Scaffolds
  - 1. The Mechanical Contractor shall provide their own ladders, scaffolds, etc. of substantial construction for access to their work in various portions of the building as may be required. When no longer needed, they shall be removed by the Contractor.
- C. Protection Devices
  - 1. The Mechanical Contractor shall provide and maintain his own necessary barricades, fences, signal lights, etc., required by all governing authorities or shown on the drawings. When no longer needed, they shall be removed by the Contractor.
- D. TEMPORARY FIRE PROTECTION
  - 1. The Mechanical Contractor shall provide all necessary first aid hand fire extinguishers for Class A, B, C and special hazards as may exist in his own work area only in accordance with good and safe practice and as required by jurisdictional safety authority.



1.13 SUBMITTALS

- A. Submittals will be required for each piece of equipment, material or product as noted in the table below. All submittals shall be submitted, reviewed and all discrepancies addressed prior to ordering equipment or starting work. Any equipment ordered without having first completed the submittal process is done at the risk of the contractor. Any work performed prior to completing the submittal process is done at the risk of the contractor.

B.

Specification Section	Product Data	Performance Data	Shop Drawing	Delegated Design	Wiring Diagram	Color Chart	Sustainability Compliance	Notes
230500	X			X				
230519	X							
230523	X							
230529	X			X				Provide Delegated Design per the requirements of this section
230548	X			X				Provide Delegated Design per the requirements of this section
230553	X							
230593								Provide T&B Certifications
230713	X	X	X				X	Provide Shop Drawings with Ductwork Plans
230716	X							
230900	X	X	X		X			Provide Shop Drawings per the requirements of this section.
230901	X	X	X		X			Provide Shop Drawings per the requirements of this section.
230902	X	X	X		X			Provide Shop Drawings per the requirements of this section.
230910	X	X	X		X			Provide Shop Drawings per the requirements of this section.
23113								
231123	X							
231124	X	X			X			
231126	X							
232113	X							
232116	X	X						
232123	X	X						
232213	X							
232216	X	X						
232223	X	X						
232300	X							
233113		X	X	X			X	
233300	X	X						
233330	X	X						
233346	X							
233423	X	X			X		X	
233424	X	X			X			

Specification Section	Product Data	Performance Data	Shop Drawing	Delegated Design	Wiring Diagram	Color Chart	Sustainability Compliance	Notes
233425	X	X			X			
233533	X	X	X					
233600	X	X					X	
233713	X	X						
233813	X	X	X				X	
233814	X	X	X				X	
235123	X	X	X					
235216	X	X			X		X	
235416	X	X			X		X	
235533	X	X			X		X	
235534	X	X			X		X	
235700	X	X						
236423	X	X	X		X		X	
236424	X	X	X		X		X	
236513	X	X	X		X		X	
237200	X	X			X		X	
237313	X	X	X		X		X	
238125	X	X			X		X	
238126	X	X			X		X	
238127	X	X	X		X		X	
238146	X	X			X		X	
238216	X	X						
238219	X	X			X		X	
238229	X	X					X	
238230	X	X			X		X	
238231	X	X			X		X	
238233	X	X					X	
238236	X	X					X	
238245	X	X					X	
238316	X	X	X		X		X	

C. Submittal Definitions

1. Product Data: Provide manufacturers' cut sheets that include general product information including but not limited to, model number, physical data, nominal capacities, and rough-in requirements.
2. Performance Data: Provide detailed performance and capacities based on project specific requirements including but not limited to: flow rates, capacities, pressure loss, temperatures, fan curves, pump curves, part load performance, sound data, and electrical characteristics.
3. Shop Drawings: Provide detailed drawings of the equipment showing overall dimensions, location of electrical and piping connection, location of anchorage points, location of electrical and control panels, and all operating, service and maintenance clearances.

4. Delegated Design: Provide detailed drawings prepared and stamped by a registered Professional Engineer, that detail pertinent design criteria, the materials and products to be installed and the required installation locations.
5. Wiring Diagram: Provide diagrams that identify, and detail required field wiring.
6. Color Chart: Provide a physical color chart of material samples required for selection of equipment colors.
7. Sustainability Compliance: Provide literature that indicates a products compliance with LEED or Green Globes. See Division 01 for additional information and requirements.

D. Submittal Formats:

1. Include the following information with each submittal:
  - a. Project Name
  - b. Submittal Date
  - c. Name of Architect
  - d. Name of Engineer
  - e. Name of General Contractor or Construction Manager
  - f. Name of Sub-Contractor
  - g. Name of firm or entity that prepared the submittal
  - h. Unique Submittal Number
  - i. Type of Submittal
  - j. Specification Section
  - k. Name or Mark of equipment or material and detail or drawings reference.
2. All Submittals with the exception of color charts or material samples shall be electronically transmitted PDFs.

E. Submittal Requirements

1. Submittals shall be submitted as a complete specification section. The submittal must include all materials and equipment for that specification section. Submittals for individual materials of equipment will be rejected without review.
2. Submittals shall be complete, clearly show item used, size, dimensions, capacity, rough in, etc., as required for complete check and installation. Manufacturer's literature showing more than one item shall be clearly marked as to which item is being furnished or it will be rejected and returned without review.
3. Each submittal shall be thoroughly checked by the Contractor for compliance with the Contract Document requirements, accuracy of dimensions, relationship to the work of other trades, and conformance with sound, safe practices as to erection and installation. Each submittal shall then bear a stamp evidencing such checking and shall show corrections made, if any. Submittals requiring extensive corrections shall be revised before submission. Each submittal not stamped and signed by the Contractor evidencing such checking will be rejected and returned without review.
4. 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 on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
5. Review of the shop drawings and literature by the engineer shall not relieve the contractor for responsibility for deviations from the drawings or specifications, nor shall it relieve the contractor from responsibility for errors in the shop drawings or literature. It is the responsibility of the contractor to provide materials and equipment which meet the specifications and job requirements.

1.14 OPERATION AND MAINTENANCE MANUALS

- A. Operation and Maintenance Manuals (O&M Manuals) shall contain:
1. Names and contact information for the Project Architect, Project Engineer.
  2. Names and contact information for the General Contractor or Construction Manager.
  3. Names and contact information for sub-contractors.
  4. Installation, maintenance and operating instructions for each piece of equipment.
  5. Parts lists
  6. Wiring Diagrams
  7. Equipment Start-up and inspection certificates
  8. Test and Balance Reports
  9. Commissioning Reports
  10. Copies of Equipment Warranties
  11. Copies of Submittals
  12. Record Drawings.
- B. Prior to substantial completion, submit an electronic copy of the O&M manual in PDF format to the Architect, Engineer and Owner for Review and approval. The PDF shall be one file with an index and hyperlinks to each section. Individual bound PDFs without automated navigation will be rejected. All O&M data shall be grouped by the equipment type and ordered by the specification numbering.
- C. Prior to final payment a final electronic copy of the O&M manual on an archival quality DVD as well as two printed copies, shall be furnished to the owner. Printed copies shall have commercial quality 8-1/2" x 11" 3-ring binders with tabbed dividers for each section.

1.15 AS-BUILT RECORD DRAWINGS

- A. The Contractor shall furnish to the Owner and Architect/Engineer a marked print showing the location of all concealed or underground pipe or conduit runs and other equipment installed other than as shown on the drawings. Dimension underground lines from established building lines. Indicate all installed pull boxes in conduit runs.
- B. The Contractor shall furnish to the Architect/Engineer a marked print showing the location of all mechanical equipment, piping, ductwork, diffusers, grilles, etc. The location of any item which deviates from the bid documents shall be accurately drawn and dimensioned.
- C. All underground piping and ductwork shall be dimensioned from nearest column and/or exterior walls. The location of all maintenance related items, such as duct access doors, fire dampers, isolation valves, filters, etc., shall be highlighted on the as built drawing.

1.16 PLACING SYSTEM INTO OPERATION

- A. Prior to the starting of equipment, the Mechanical Contractor shall thoroughly inspect the installation and any work completed by other trades and subcontractors to verify compliance with the contract documents.
- B. Start-up of all HVAC equipment shall be completed by factory trained representatives. At the completion of start-up, the factory representative shall submit to the architect and engineer, a start-up report that indicates any problems encountered, potential problems including installation issues, adjustments made or required to be made to ensure proper operation of the equipment. Any installation deficiencies identified shall be corrected at no additional cost to the owner.

1.17 OWNER TRAINING

A. General

1. The system training is intended to familiarize the Owner's operating and maintenance staff with all systems requiring maintenance. Training is to be provided after the systems are in place and operational, after issues noted during commissioning have been resolved, and before final acceptance.
2. Provide second set of training sessions for automatic control systems about 6-9 months after the first sessions.

B. Systems Requiring Training

1. All mechanical, electrical, safety, standby, and automatic control systems in the project, and other systems specified elsewhere to have training.

C. Attendance:

1. Training is to be provided by contractor's representatives that are familiar with the system's operation and maintenance requirements. Individual training sessions (modules) shall be provided for each type or group of systems, separated roughly by trade group that will be performing maintenance on the system. The trades groups and systems typically requiring training are:
  - a. Heating Plant (Hydronic and steam heating systems, fan systems, controls)
  - b. HVAC & Refrigeration (Hydronic and or steam heating systems, refrigeration, chilled water, packaged cooling systems, packaged rooftop units, fan systems, controls)

D. Schedule:

1. Duplicate training sessions are to be provided for each training module, so that the Owner's operating personnel can be split into two groups during training. Duplicate training sessions shall be scheduled on different days. Length of training sessions will be determined by scope of training indicated below, and as coordinated with Owner after draft copy of training documents have been reviewed.

E. Training Documentation:

1. Contractor to submit draft copy of agenda and training documents to Owner for review at least two weeks prior to training date.
2. Provide a copy of the following items for each person that will be attending the training sessions. Coordinate required number with the Owner.
  - a. Training agenda.
  - b. Summary of new systems and existing systems affected by this project.
  - c. Summary of work performed under this project.
  - d. Control system drawings and sequences of operation.
  - e. List of important maintenance and trouble-shooting operations for all systems.
3. Provide minimum of 2 copies of following items:
  - a. Contract documents including all drawings, specifications, addendums, and change orders.

F. Training Sessions:

1. Assemble at location to be determined by the Owner.

2. Distribute training documentation as indicated above.
3. Provide classroom style training if required for orientation and discussion of new systems and existing systems affected by this project, and other issues appropriate for a classroom format.
4. Visit site and review locations; and perform detailed review of operation and maintenance requirements for current systems.

1.18 WARRANTY

- A. The Contractor shall guarantee that all materials and labor installed are new and of first quality and that any material or labor found defective shall be replaced without cost to the Owner within one (1) year after substantial completion of the Contract or one (1) full season of heating and cooling operation, whichever is the greater. The guarantee shall list the date of the beginning of the one (1) year period, which shall be the date that the Substantial Completion Certificate is issued.
- B. Any damage to the building, caused by defective work or material of the Contractor within the above-mentioned period, shall be satisfactorily repaired without cost to the Owner.
- C. The guarantee does not include maintenance of equipment. The Owner shall accept full responsibility for proper operation and maintenance of equipment immediately upon substantial completion and occupancy of the building.
- D. Final acceptance by the Owner will not occur until all operating instructions are mounted in Equipment Rooms and Operating Personnel are thoroughly indoctrinated in the operation of all mechanical equipment by the Contractor.
- E. No equipment installed as part of this project shall be used for temporary heat during construction.

END OF SECTION 23 00 00

## SECTION 23 05 00 - GENERAL PROVISIONS OF HVAC

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section includes the following:
  - 1. Assembly Penetrations
  - 2. Silicone Sealants

#### 1.02 SUBMITTALS

- A. See Section 23 00 00 "General Requirements of HVAC" for Submittal requirements.

#### 1.03 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

#### 1.04 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

### PART 2 - PRODUCTS

#### 2.01 ASSEMBLY PENETRATIONS

- A. All penetrations through a fire rated assembly shall be protected with an approved fire stop system in compliance with the rated assemblies as outlined in the Underwriters Laboratory Listing.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. 3M Company
    - b. Holdrite
    - c. Hilti

#### 2.02 SILICONE SEALANTS

- A. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.

END OF SECTION 230500



## SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

### PART 1 - GENERAL

#### 1.01 SUMMARY

A. Section Includes:

1. Balancing Air Systems:
  - a. Constant-volume air systems.
  - b. Variable-air-volume systems.
2. Balancing Hydronic Piping Systems:
  - a. Constant-flow hydronic systems.
  - b. Variable-flow hydronic systems.

#### 1.02 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- F. TDH: Total dynamic head.

#### 1.03 ACTION SUBMITTALS

- A. See Section 23 00 00 "General Requirement of HVAC" for submittal requirements

#### 1.04 QUALITY ASSURANCE

- A. TAB Specialists Qualifications: Certified by AABC, NEBB, TABB, or as approved by the Engineer prior to bidding.
- B. Certify TAB field data reports and perform the following:
  1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
  2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- C. TAB Report Forms: Use standard TAB contractor's forms.

- D. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- E. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

## PART 2 - PRODUCTS

### 2.01 Test and Balance Contractors:

- A. The following companies are pre-approved. Companies not listed below must submit for approval prior to bidding the project:
  - 1. Neurdorfer Engineers, Vancouver,
  - 2. WAAirCommander, Spokane, WA
  - 3. Accurate Balancing Agency Inc, Portland, OR
  - 4. AIR Introduction and Regulation, Coburg, OR

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
  - 1. Airside:
    - a. Duct systems are complete with terminals installed.
    - b. Volume, smoke, and fire dampers are open and functional.
    - c. Clean filters are installed.
    - d. Fans are operating, free of vibration, and rotating in correct direction.
    - e. Variable-frequency controllers' startup is complete and safeties are verified.
    - f. Automatic temperature-control systems are operational.
    - g. Ceilings are installed.
    - h. Windows and doors are installed.
    - i. Suitable access to balancing devices and equipment is provided.

### 3.02 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance", NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
  - 1. After testing and balancing, patch probe holes in ducts with plastic plugs.
  - 2. Coordinate with the mechanical insulation contractor to Restore insulation, coverings, vapor barrier, and finish according to Section 23 07 13 "Duct Insulation,"

Section 23 07 16 "HVAC Equipment Insulation," and Section 23 07 19 "HVAC Piping Insulation."

- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

3.03 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- D. Check dampers for proper position to achieve desired airflow path.
- E. Check for airflow blockages.
- F. Verify that air duct system is sealed as specified in Section 23 31 13 "Metal Ducts."

3.04 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
  - 1. Measure airflow of submain and branch ducts.
  - 2. Adjust submain and branch duct volume dampers for specified airflow.
  - 3. Re-measure each submain and branch duct after all have been adjusted.
- B. Adjust air inlets and outlets for each space to indicated airflows.
  - 1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
  - 2. Measure inlets and outlets airflow.
  - 3. Adjust each inlet and outlet for specified airflow.
  - 4. Re-measure each inlet and outlet after they have been adjusted.

3.05 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
  - 1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
  - 2. If calculations increase or decrease the air flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
  - 3. Balance each air outlet.

3.06 TOLERANCES

- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
  - 1. Air Outlets and Inlets: Plus or minus 10 percent.
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.07 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
  - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
  - 2. Include a list of instruments used for procedures, along with proof of calibration.
  - 3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
  - 1. Field test reports prepared by system and equipment installers.
  - 2. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
  - 1. Title page.
  - 2. Name and address of the TAB specialist.
  - 3. Project name.
  - 4. Project location.
  - 5. Architect's name and address.
  - 6. Engineer's name and address.
  - 7. Contractor's name and address.
  - 8. Report date.
  - 9. Signature of TAB supervisor who certifies the report.
  - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  - 11. Summary of contents including the following:
    - a. Indicated versus final performance.
    - b. Notable characteristics of systems.
    - c. Description of system operation sequence if it varies from the Contract Documents.
  - 12. Nomenclature sheets for each item of equipment.
  - 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
  - 14. Notes to explain why certain final data in the body of reports vary from indicated values.
- D. Instrument Calibration Reports:
  - 1. Report Data:
    - a. Instrument type and make.

- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

3.08 ADDITIONAL TESTS

- A. Within 120 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

END OF SECTION 23 05 93

## SECTION 23 07 13 - DUCT INSULATION

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section includes insulating the following duct services:
  - 1. Indoor, Duct Insulation.
  - 2. Outdoor Duct Insulation.
  - 3. Fire Rated Duct Insulation.
- B. Related Sections:
  - 1. Section 23 07 16 "HVAC Equipment and Piping Insulation."
  - 2. Section 23 31 13 "Metal Ducts" for duct liners.

#### 1.02 ACTION SUBMITTALS

- A. See Section 23 00 00 "General Requirements of HVAC" for submittal requirements.
- B. Provide floor plan shop drawings showing intended locations of insulation. Exposed ductwork that is to not be insulated shall be specifically noted.

#### 1.03 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.04 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

### PART 2 - PRODUCTS

#### 2.01 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.

- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. Knauf Insulation.
    - d. Owens Corning.
- G. Jacketed Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. Knauf Insulation.
    - d. Owens Corning.
- H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation without factory-applied jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. Knauf Insulation.
    - d. Owens Corning.

## 2.02 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 1-hour fire rating by an NRTL acceptable to authorities having jurisdiction.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. 3M.
  - b. CertainTeed Corporation.
  - c. Johns Manville; a Berkshire Hathaway company.
  - d. Thermal Ceramics.

## 2.03 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

## 2.04 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
  1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
  2. Service Temperature Range: Minus 20 to plus 180 deg F.
  3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  4. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
  1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
  2. Service Temperature Range: Minus 20 to plus 180 deg F.
  3. Solids Content: 60 percent by volume and 66 percent by weight.
  4. Color: White.

## 2.05 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
  1. Materials shall be compatible with insulation materials, jackets, and substrates.
  2. Fire- and water-resistant, flexible, elastomeric sealant.
  3. Service Temperature Range: Minus 40 to plus 250 deg F.
  4. Color: Aluminum.
- B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:
  1. Materials shall be compatible with insulation materials, jackets, and substrates.
  2. Fire- and water-resistant, flexible, elastomeric sealant.
  3. Service Temperature Range: Minus 40 to plus 250 deg F.



4. Color: White.

## 2.06 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
  1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
  2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
  3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

## 2.07 FIELD-APPLIED JACKETS

- A. Self-Adhesive Outdoor Jacket: 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting a rubberized bitumen compound; heat applied to a multi-ply embossed UV-resistant aluminum foil/polymer laminate, and polyester/foil multiple layer laminate with acrylic adhesive.
  1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Polyguard Products, Inc.
    - b. Prior Approved Equal

## 2.08 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
  1. Width: 3 inches.
  2. Thickness: 11.5 mils.
  3. Adhesion: 90 ounces force/inch in width.
  4. Elongation: 2 percent.
  5. Tensile Strength: 40 lbf/inch in width.
  6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
  1. Width: 3 inches.
  2. Thickness: 6.5 mils.
  3. Adhesion: 90 ounces force/inch in width.
  4. Elongation: 2 percent.
  5. Tensile Strength: 40 lbf/inch in width.
  6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
  1. Width: 2 inches.

2. Thickness: 3.7 mils.
3. Adhesion: 100 ounces force/inch in width.
4. Elongation: 5 percent.
5. Tensile Strength: 34 lbf/inch in width.

## 2.09 SECUREMENTS

- A. Cupped Head Weld Pins:
1. Material: Low carbon steel.
  2. Finish: Copper coated pins with galvanized washer
  3. Pin gauge: 12 Ga.
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- C. Wire: 0.080-inch nickel-copper alloy.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

### 3.02 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
  2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

### 3.03 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
1. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- E. Insulation Installation at Floor Penetrations:
1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
  2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."
- 3.04 INSTALLATION OF MINERAL-FIBER INSULATION
- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Impale insulation over pins and attach speed washers.
    - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
  5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
  6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

- a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
  - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

### 3.05 OUTDOOR DUCT INSULATION INSTALLATION

- A. Cover all sides of ductwork with jacketed mineral-fiber board insulation. Insulation on the top of the ductwork must be installed in such a manner as to allow 'water-shed' from the top of the duct to prevent water from 'ponding' on top of the ductwork.
- B. Install self-adhesive outdoor jacket over board insulation according the jacket manufacturers written instructions. All joint in jacketing must overlap by 6" minimum.
- C. Insulation and jacketing must be continuous and may not be interrupted by duct supports or hangers.

### 3.06 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 07 84 13 "Penetration Firestopping."

### 3.07 FINISHES

- A. Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
- B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- C. Do not field paint outdoor ductwork.

### 3.08 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect ductwork, randomly selected by engineer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.09 DUCT INSULATION SCHEDULE, GENERAL

- A. Duct insulation shall not be installed on indoor supply or return ductwork that is exposed to view in a normally occupied and conditioned space unless otherwise indicated on the drawings.
- B. Insulation materials and thicknesses for ductwork are identified in the table below. If more than one material is listed for an application, selection from materials listed is at the Contractor's option. Ductwork that is not listed below or is exposed to view shall not be insulated.

Location	Application	Insulation Type	Installed R-Value **	Vapor Barrier	Factory Installed Jacket Type
Indoor	Supply	Mineral-Fiber Blanket	6	YES	FSK
Indoor	Exhaust*	Mineral-Fiber Blanket	12	YES	FSK
Unconditioned Space	Supply, Return & Exhaust	Mineral-Fiber Board	12	YES	FSK

\*Indoor Exhaust Ductwork shall be insulated from the penetration of the building envelope to 10ft upstream of a backdraft of shutoff damper.

\*\* All above values are a minimum and shall be superseded by more stringent currently adopted Energy or Mechanical Code.

END OF SECTION 23 07 13

## SECTION 23 08 00 - COMMISSIONING OF HVAC SYSTEMS

### PART 1 - GENERAL

#### 1.01 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.
- B. The OPR and BOD documentation are included by reference for information only.
- C. Division 01 section 'LEED Requirements' for additional LEED requirements.

#### 1.02 SUMMARY

- A. This section includes commissioning process requirements for HVAC&R systems, assemblies, and equipment.
- B. Related Sections:
  - 1. Division 01 Section 01 91 13 "General Commissioning Requirements" for general commissioning process requirements.

#### 1.03 DESCRIPTION

- A. Refer to Division 01 Section 01 91 13 "General Commissioning Requirements" for the description of commissioning.

#### 1.04 DEFINITIONS

- A. Refer to Division 01 Section 01 91 13 "General Commissioning Requirements" for definitions.

#### 1.05 SUBMITTALS

- A. Refer to Division 01 Section 01 91 13 "General Commissioning Requirements" for CxA's role.
- B. Refer to Division 01 Section "Submittals" for specific requirements.
- C. In addition, provide the following:
  - 1. Certificates of readiness
  - 2. Certificates of completion of installation, prestart, and startup activities.
  - 3. O&M manuals
  - 4. Test reports
- D. Control Drawings Submittal
  - 1. The control drawings shall have a key to all abbreviations.
  - 2. The control drawings shall contain graphic schematic depictions of the systems and each component.



3. The schematics will include the system and component layout of any equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
4. Provide a full points list with at least the following included for each point:
  - a. Controlled system
  - b. Point abbreviation
  - c. Point description
  - d. Display unit
  - e. Control point or set point (Yes / No)
  - f. Monitoring point (Yes / No)
  - g. Intermediate point (Yes / No)
  - h. Calculated point (Yes / No)

#### 1.06 QUALITY ASSURANCE

- A. Test Equipment Calibration Requirements: Contractors will comply with test manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately after instruments have been repaired resulting from being dropped or damaged. Affix calibration tags to test instruments. Furnish calibration records to CxA upon request.

#### 1.07 COORDINATION

- A. Refer to Division 01 Section "General Commissioning Requirements" for requirements pertaining to coordination during the commissioning process.

### PART 2 - PRODUCTS

#### 2.01 TEST EQUIPMENT

- A. All standard testing equipment required to perform startup, initial checkout and functional performance testing shall be provided by the Contractor for the equipment being tested. For example, the mechanical contractor of Division 23 shall ultimately be responsible for all standard testing equipment for the HVAC&R system and controls system in Division 23, except for equipment specific to and used by TAB in their commissioning responsibilities. A sufficient quantity of two-way radios shall be provided by each subcontractor.
- B. Special equipment, tools and instruments (specific to a piece of equipment and only available from vendor) required for testing shall be included in the base bid price to the Owner and left on site, except for stand-alone data logging equipment that may be used by the CxA.
- C. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the Owner upon completion of the commissioning process.
- D. Data logging equipment and software required to test equipment will be provided by the CxA, but shall not become the property of the Owner.

- E. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5°F and a resolution of + or - 0.1°F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year.

### PART 3 - EXECUTION

#### 3.01 GENERAL DOCUMENTATION REQUIREMENTS

- A. With assistance from the installing contractors, the CxA will prepare Pre-Functional Checklists for all commissioned components, equipment, and systems
- B. Red-lined Drawings:
  - 1. The contractor will verify all equipment, systems, instrumentation, wiring and components are shown correctly on red-lined drawings.
  - 2. Preliminary red-lined drawings must be made available to the Commissioning Team for use prior to the start of Functional Performance Testing.
  - 3. Changes, as a result of Functional Testing, must be incorporated into the final as-built drawings, which will be created from the red-lined drawings.
  - 4. The contracted party, as defined in the Contract Documents will create the as-built drawings.
- C. Operation and Maintenance Data:
  - 1. Contractor will provide a copy of O&M literature within 45 days of each submittal acceptance for use during the commissioning process for all commissioned equipment and systems.
  - 2. The CxA will review the O&M literature once for conformance to project requirements.
  - 3. The CxA will receive a copy of the final approved O&M literature once corrections have been made by the Contractor.
- D. Demonstration and Training:
  - 1. Contractor will provide demonstration and training as required by the specifications.
  - 2. A complete training plan and schedule must be submitted by the contractor to the CxA four weeks (4) prior to any training.
  - 3. A training agenda for each training session must be submitted to the CxA one (1) week prior to the training session.
  - 4. The CxA shall be notified at least 72 hours in advance of scheduled tests so that testing may be observed by the CxA and Owner's representative. A copy of the test record shall be provided to the CxA, Owner, and Architect.
  - 5. Engage a Factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specific equipment.
  - 6. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, trouble shooting, servicing, and maintaining equipment.
  - 7. Review data in O&M Manuals.
- E. Systems manual requirements:

1. The Systems Manual is intended to be a usable information resource containing all of the information related to the systems, assemblies, and Commissioning Process in one place with indexes and cross references.
2. The GC shall include final approved versions of the following information for the Systems Manual:
  - a. As-Built System Schematics
  - b. Verified Record Drawings
  - c. Test Results (not otherwise included in Cx Record)
  - d. Periodic Maintenance Information for computer maintenance management system
  - e. Recommendations for recalibration frequency of sensors and actuators
  - f. A list of contractors, subcontractors, suppliers, architects, and engineers involved in the project along with their contact information
  - g. Training Records, Information on training provided, attendees list, and any on-going training
3. This information shall be organized and arranged by building system, such as fire alarm, chilled water, heating hot water, etc.
4. Information should be provided in an electronic version to the extent possible. Legible, scanned images are acceptable for non-electronic documentation to facilitate this deliverable.

### 3.02 CONTRACTOR'S RESPONSIBILITIES

- A. Mechanical, Controls and TAB Contractors. The commissioning responsibilities applicable to each of the mechanical, controls and TAB contractors of Division 23 are as follows (all references apply to commissioned equipment only):
  - B. Perform commissioning tests at the direction of the CxA.
  - C. Attend construction phase controls coordination meetings.
  - D. Attend testing, adjusting, and balancing review and coordination meetings.
  - E. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
  - F. Provide information requested by the CxA for final commissioning documentation.
  - G. Include requirements for submittal data, operation and maintenance data, and training in each purchase order or sub-contract written.
  - H. Prepare preliminary schedule for Mechanical system orientations and inspections, operation and maintenance manual submissions, training sessions, pipe and duct system testing, flushing and cleaning, equipment start-up, testing and balancing and task completion for owner. Distribute preliminary schedule to commissioning team members.
  - I. Update schedule as required throughout the construction period.
  - J. During the startup and initial checkout process, execute the related portions of the prefunctional checklists for all commissioned equipment.
  - K. Assist the CxA in all verification and functional performance tests.

- L. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.
- M. Gather operation and maintenance literature on all equipment, and assemble in binders as required by the specifications. Submit to CxA (45) days after submittal acceptance.
- N. Coordinate with the CxA to provide (48) hour advance notice so that the witnessing of equipment and system start-up and testing can begin.
- O. Notify the CxA a minimum of (2) weeks in advance of the time for start of the testing and balancing work. Attend the initial testing and balancing meeting for review of the official testing and balancing procedures.
- P. Participate in, and schedule vendors and contractors to participate in the training sessions.
- Q. Provide written notification to the CM/GC and CxA Authority that the following work has been completed in accordance with the contract documents, and that the equipment, systems, and sub-system are operating as required.
  - 1. HVAC&R equipment including all fans, air handling units, ductwork, dampers, terminals, and all other equipment furnished under this Division.
  - 2. Fire stopping in the fire rated construction, including fire and smoke damper installation, caulking, gasketing and sealing of smoke barriers.
  - 3. Fire detection and smoke detection devices furnished under other divisions of the specification.
- R. The equipment supplier shall document the performance of his equipment.
- S. Provide a complete set of red-lined drawings to the CxA prior to the start of Functional Performance Testing.
- T. Test, Adjust and Balance Contractor
  - 1. Attend initial commissioning coordination meeting scheduled by the Commissioning Authority.
  - 2. Submit the site specific testing and balancing plan to the CxA and AE for review and acceptance.
  - 3. Attend the testing and balancing review meeting scheduled by the CxA. Be prepared to discuss the procedures that shall be followed in testing, adjusting, and balancing the HVAC&R system.
  - 4. At the completion of the testing and balancing work, and the submittal of the final testing and balancing report, notify the HVAC&R contractor and the CM/GC.
  - 5. At the completion of testing and balancing work, and the submittal of the final testing and balancing report, notify the HVAC&R Contractor and the CM/GC.
  - 6. Participate in verification of the testing and balancing report, which will consist of repeating measurements contained in the testing and balancing reports. Assist in diagnostic purposes when directed.
- U. Provide training of the Owner's operating staff using expert qualified personnel, as specified.
- V. Equipment Suppliers
  - 1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner, to keep warranties in force.
  - 2. Assist in equipment testing per agreements with contractors.

3. Provide information requested by CxA regarding equipment sequence of operation and testing procedures.

- W. Refer to Division 01 Section "General Commissioning Requirements" for additional contractor responsibilities.

### 3.03 OWNER'S RESPONSIBILITIES

- A. Refer to Division 01 Section 01 91 13 "General Commissioning Requirements" for Owner's Responsibilities.

### 3.04 DESIGN PROFESSIONAL'S RESPONSIBILITIES

- A. Refer to Division 01 Section 01 91 13 "General Commissioning Requirements" for Design Professional's Responsibilities.

### 3.05 CxA'S RESPONSIBILITIES

- A. Refer to Division 01 Section 01 91 13 "General Commissioning Requirements" for CxA's Responsibilities.

### 3.06 TESTING PREPARATION

- A. Certify in writing to the CxA that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify in writing to the CxA that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- C. Certify in writing that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
- D. Place systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- E. Inspect and verify the position of each device and interlock identified on checklists.
- F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
- G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

### 3.07 TESTING, ADJUSTING AND BALANCING VERIFICATION

- A. Prior to performance of Testing, Adjusting and Balancing work, provide copies of reports, sample forms, checklists, and certificates to the CxA.

- B. Notify the CxA at least ten (10) days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.
- C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.
  - 1. The CxA will notify testing and balancing subcontractor ten (10) days in advance of the date of field verification. Notice will not include data points to be verified.
  - 2. The testing and balancing subcontractor shall use the same instruments (by model and serial number) that were used when original data were collected.
  - 3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
  - 4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

### 3.08 GENERAL TESTING REQUIREMENTS

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.
- C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- D. The CxA along with the HVAC&R contractor, testing and balancing Subcontractor, and HVAC&R Instrumentation and Control Subcontractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.
- E. Tests will be performed using design conditions whenever possible.
- F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- G. The CxA may direct that set points be altered when simulating conditions is not practical.
- H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.09 HVAC&R SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

- A. Equipment Testing and Acceptance Procedures: Testing requirements are specified in individual Division 23 sections. Provide submittals, test data, inspector record, and certifications to the CxA.
- B. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in *Division 23 Section 23 09 93 "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls."* Assist the CxA with preparation of testing plans.
- C. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment: Test requirements are specified in Division 23 piping Sections. HVAC&R Contractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:
  - 1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
  - 2. Description of equipment for flushing operations.
  - 3. Minimum flushing water velocity.
  - 4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.
- D. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of chillers, cooling towers, refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.
- E. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.
- F. The work included in the commissioning process involves a complete and thorough evaluation of the operation and performance of all components, systems and sub-systems. The following equipment and systems shall be evaluated:
  - 1. Verification of Testing, Adjusting and Balancing

3.10 DEFICIENCIES/NON-CONFORMANCE, COST OF RETESTING, FAILURE DUE TO MANUFACTURER DEFECT

- A. Refer to Division 01 Section "General Commissioning Requirements" for requirements pertaining to deficiencies/non-conformance, cost of retesting, or failure due to manufacturer defect.

3.11 APPROVAL

- A. Refer to Division 01 Section 01 91 13 "General Commissioning Requirements" for approval procedures.

3.12 DEFERRED TESTING

- A. Refer to Division 01 Section "General Commissioning Requirements" for requirements pertaining to deferred testing.

3.13 OPERATION AND MAINTENANCE MANUALS

- A. The Operation and Maintenance Manuals shall conform to Contract Documents requirements as stated in Division 01.
- B. Refer to Division 01 Section "General Commissioning Requirements" for the AE and CxA roles in the Operation and Maintenance Manual contribution, review and approval process.
- C. An updated as-built version of the control drawings and sequences of operation shall be included in the final controls O&M manual submittal.

3.14 TRAINING OF OWNER PERSONNEL

- A. Refer to Division 01 Section 01 91 13 "General Commissioning Requirements" for requirements pertaining to training.
- B. Mechanical Contractor. The mechanical contractor shall have the following training responsibilities:
  - 1. Provide the CxA with a training plan two weeks before the planned training.
  - 2. Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of HVAC equipment.
  - 3. Training shall consist of hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.
  - 4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
  - 5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.
  - 6. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.
  - 7. Training shall include:
    - a. Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.
    - b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.
    - c. Discussion of relevant health and safety issues and concerns.
    - d. Discussion of warranties and guarantees.
    - e. Common troubleshooting problems and solutions.



- f. Explanatory information included in the O&M manuals and the location of all plans and manuals in the facility.
    - g. Discussion of any peculiarities of equipment installation or operation.
    - h. The format and training agenda in The HVAC Commissioning Process, ASHRAE Guideline 1-2007, is recommended.
  - 8. Training shall occur after functional testing is complete, unless approved otherwise by the Owner.
- C. TAB. The TAB contractor shall have the following training responsibilities:
  - 1. TAB shall meet with facility staff after completion of TAB and instruct them on the following:
    - a. Go over the final TAB report, explaining the layout and meanings of each data type.
    - b. Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.
    - c. Identify and discuss any duct runs, diffusers that are close to or are not meeting their design capacity.
    - d. Discuss any temporary settings and steps to finalize them for any areas that are not finished.
    - e. Other salient information that may be useful for facility operations, relative to TAB.

END OF SECTION 23 08 00

## SECTION 23 31 13 - METAL DUCTS

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes:
  - 1. Rectangular ducts and fittings.
  - 2. Round ducts and fittings.
  - 3. Sheet metal materials.
  - 4. Sealants and gaskets.
  - 5. Hangers and supports.
  - 6. Seismic-restraint devices.
- B. Related Sections:
  - 1. Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
  - 2. Section 23 33 00 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ANSI/ASHRAE 62.1.

#### 1.02 SUBMITTALS

- A. See Section 23 00 00 "General Requirements of HVAC" for submittal requirements.

#### 1.03 QUALITY ASSURANCE

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- B. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

### PART 2 - PRODUCTS

#### 2.01 RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.02 ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. Transverse Joints in Ducts Larger Than 24 in Diameter: Flanged.
- C. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.03 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Galvanized Coating Designation: G90.
  - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- F. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

## 2.04 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Water-Based Joint and Seam Sealant:
  1. Application Method: Brush on.
  2. Solids Content: Minimum 65 percent.
  3. Shore A Hardness: Minimum 20.
  4. Water resistant.
  5. Mold and mildew resistant.
  6. VOC: Maximum 75 g/L (less water).
  7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  8. Service: Indoor or outdoor.
  9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- C. Flanged Joint Sealant: Comply with ASTM C 920.
  1. General: Single-component, acid-curing, silicone, elastomeric.
  2. Type: S.
  3. Grade: NS.
  4. Class: 25.
  5. Use: O.
  6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- E. Round Duct Joint O-Ring Seals:
  1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
  2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
  3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

## 2.05 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
  - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
  - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

### PART 3 - EXECUTION

#### 3.01 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

### 3.02 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts at a minimum to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
  - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 2. Outdoor, Supply-Air Ducts: Seal Class A.
  - 3. Outdoor, Exhaust Ducts: Seal Class C.
  - 4. Outdoor, Return-Air Ducts: Seal Class C.
  - 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
  - 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
  - 7. Unconditioned Space, Exhaust Ducts: Seal Class C.
  - 8. Unconditioned Space, Return-Air Ducts: Seal Class B.
  - 9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
  - 10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
  - 11. Conditioned Space, Exhaust Ducts: Seal Class B.
  - 12. Conditioned Space, Return-Air Ducts: Seal Class C.

### 3.03 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.
  - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
  - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum

Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 3.04 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems." And ASCE/SEI 7.

### 3.05 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 23 33 00 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### 3.06 START UP

- A. Air Balance: Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC."

### 3.07 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
- B. Supply Ducts:
  - 1. Ducts Connected to Fan Coil Units and Terminal Units:
    - a. Pressure Class: Positive 2-inch wg.
    - b. Minimum SMACNA Seal Class: C.
    - c. SMACNA Leakage Class for Rectangular: 16.
    - d. SMACNA Leakage Class for Round and Flat Oval: 8.
  - 2. Ducts Connected to Variable-Air-Volume Air-Handling Units:
    - a. Pressure Class: Positive 3-inch wg.
    - b. Minimum SMACNA Seal Class: B.
    - c. SMACNA Leakage Class for Rectangular: 8.
    - d. SMACNA Leakage Class for Round and Flat Oval: 4.
  - 3. Ducts Connected to Equipment Not Listed Above:
    - a. Pressure Class: Positive 2-inch wg.
    - b. Minimum SMACNA Seal Class: C.
    - c. SMACNA Leakage Class for Rectangular: 16.

- d. SMACNA Leakage Class for Round and Flat Oval: 8.
- C. Exhaust Ducts:
  - 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
    - a. Pressure Class: Negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: C if negative pressure, and A if positive pressure.
    - c. SMACNA Leakage Class for Rectangular: 16.
    - d. SMACNA Leakage Class for Round and Flat Oval: 8.
  - 2. Ducts Connected to Air-Handling Units:
    - a. Pressure Class: Positive or negative 3-inch wg.
    - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
    - c. SMACNA Leakage Class for Rectangular: 8.
    - d. SMACNA Leakage Class for Round and Flat Oval: 4.
- D. Intermediate Reinforcement:
  - 1. Galvanized-Steel Ducts: Galvanized steel.
  - 2. PVC-Coated Ducts:
    - a. Exposed to Airstream: Match duct material.
    - b. Not Exposed to Airstream: Galvanized.
  - 3. Stainless-Steel Ducts:
    - a. Exposed to Airstream: Match duct material.
    - b. Not Exposed to Airstream: Match duct material.
  - 4. Aluminum Ducts: Aluminum.
- E. Elbow Configuration:
  - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
    - a. Velocity 1000 fpm or Lower:
      - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
      - 2) Mitered Type RE 4 without vanes.
    - b. Velocity 1000 to 1500 fpm:
      - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
      - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
      - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
    - c. Velocity 1500 fpm or Higher:
      - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
      - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
      - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
  - 2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
    - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
    - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.



- c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
  - 3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
    - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
      - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
      - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
      - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
      - 4) Radius-to Diameter Ratio: 1.5.
    - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
    - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.
- F. Branch Configuration:
  - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
    - a. Rectangular Main to Rectangular Branch: 45-degree entry.
    - b. Rectangular Main to Round Branch: Spin in.
  - 2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
    - a. Velocity 1000 fpm or Lower: 90-degree tap.
    - b. Velocity 1000 to 1500 fpm: Conical tap.
    - c. Velocity 1500 fpm or Higher: 45-degree lateral.
- G. Liner:
  - 1. Sustainable design requiring compliance with ASHRAE/IES 90.1 must have duct insulation with an R-value that complies with tables titled "Minimum Duct Insulation R-Value, Cooling and Heating Only Supply Ducts and Return Ducts" and "Minimum Duct Insulation R-Value, Combined Heating and Cooling Supply Ducts and Return Ducts." If using liner alone to satisfy thermal requirements, verify that material selected is available in thickness needed to provide thermal performance without jeopardizing other requirements.
  - 2. Supply-Air Ducts: Fibrous glass, Type I or Flexible elastomeric, 1 inches thick
  - 3. Return-Air Ducts: Fibrous glass, Type I or Flexible elastomeric, 1 Exhaust-Air Ducts: Fibrous glass, Type I or Flexible elastomeric, 1 inches thick.
  - 4. Supply Fan Plenums: Fibrous glass, Type I or Flexible elastomeric, 1 inches thick.
  - 5. Return- and Exhaust-Fan Plenums: Fibrous glass, Type II or Flexible elastomeric or Natural fiber, 2 inches thick.
  - 6. Transfer Ducts: Fibrous glass, Type I or Flexible elastomeric, 1 inches thick.

END OF SECTION 23 31 13

## SECTION 23 33 00 - AIR DUCT ACCESSORIES

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes:
  - 1. Backdraft and pressure relief dampers.
  - 2. Manual volume dampers.
  - 3. Fire dampers.
  - 4. Smoke dampers.
  - 5. Flange connectors.
  - 6. Turning vanes.
  - 7. Duct-mounted access doors.
  - 8. Duct accessory hardware.
- B. Related Requirements:
  - 1. Section 28 31 11 "Digital, Addressable Fire-Alarm System" for duct-mounted fire and smoke detectors.

#### 1.02 SUBMITTALS

- A. See section 23 00 00 "General Requirements of HVAC" for submittal requirements.

### PART 2 - PRODUCTS

#### 2.01 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

#### 2.02 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Galvanized Coating Designation: G90.
  - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a 2D finish for concealed ducts and 2BA finish for exposed ducts.
- C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

## 2.03 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Greenheck Products; a division of MESTEK, Inc.
  - 2. Nailor Industries Inc.
  - 3. Ruskin Company.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 1000 fpm.
- D. Maximum System Pressure: 4.5 inch wg.
- E. Frame: Hat-shaped, 0.063-inch-thick extruded aluminum, with welded corners or mechanically attached and mounting flange.
- F. Blades: Multiple single-piece blades, end pivoted, maximum 6-inch width, 0.025-inch-thick, roll-formed aluminum with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Extruded vinyl, mechanically locked.
- I. Blade Axles:
  - 1. Material: Nonmetallic.
  - 2. Diameter: 0.20 inch.
- J. Bearings: synthetic pivot bushings.
- K. Accessories:
  - 1. Adjustment device to permit setting for varying differential static pressure.
  - 2. Counterweights and spring-assist kits for vertical airflow installations.
  - 3. Electric actuators.
  - 4. Chain pulls.
  - 5. Screen Mounting: Front mounted in sleeve.
    - a. Sleeve Thickness: 20 gage minimum.
    - b. Sleeve Length: 6 inches minimum.
  - 6. Screen Mounting: Rear mounted.
  - 7. Screen Material: Aluminum.
  - 8. Screen Type: Bird.
  - 9. 90-degree stops.

## 2.04 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Greenheck Products; a division of MESTEK, Inc.
  - b. Nailor Industries Inc.
  - c. Ruskin Company.
2. Standard leakage rating.
3. Suitable for horizontal or vertical applications.
4. Frames:
  - a. Frame: 16 gauge galvanized steel, 5 in deep
  - b. Mitered and welded corners.
  - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
  - a. Multiple or single blade.
  - b. Parallel- or opposed-blade design.
  - c. Stiffen damper blades for stability.
  - d. 16 gauge galvanized steel with V groove for stiffness.
6. Blade Axles: Galvanized steel.
7. Bearings:
  - a. Molded synthetic.
  - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
8. Tie Bars and Brackets: Galvanized steel.
9. Locking Quadrant handles

## 2.05 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Greenheck Products; a division of MESTEK, Inc.
  2. Nailor Industries Inc.
  3. Ruskin Company.
- B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000 ft/min velocity.
- D. Fire Rating: 1-1/2 and 3 hours as required by the wall, floor or ceiling assembly rating.
- E. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
  1. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Galvanized curtain type.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 212 deg F rated, fusible links.

K. Access Door

2.06 COMBINATION SMOKE & FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Greenheck Products; a division of MESTEK, Inc.
  - 2. Nailor Industries Inc.
  - 3. Ruskin Company.
- B. Smoke Detector: Shall be provided by the fire alarm contractor and shall be addressable type for integration into addressable fire alarm system. The smoke detector that be provided with a keyed remote test switch, field verify the installation location with owner and engineer.
- C. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel, with mechanically attached corners and mounting flange.
- D. Blades: Airfoil-shaped, single piece, double skin. Minimum 14 gage equivalent thickness, galvanized steel. Maximum 6 inches (152 mm).
- E. Blade Seals: Inflatable silicone fiberglass material to maintain smoke leakage rating to a minimum of 450F and galvanized steel for flame seal to 1,900F.
- F. Bearings: Self-lubricating stainless-steel sleeve, turning in extruded hole in frame.
- G. Axels: Minimum ½ inch diameter plated steel, hex-shaped, mechanically attached to blade.
- H. Linkage: Concealed in frame.
- I. Leakage: Class II.
- J. Rated pressure and velocity to exceed design airflow conditions.
- K. Mounting Sleeve: Factory-installed, 20 gage galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.
- L. Access Door
- M. Damper Motors: two-position action.
- N. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors.
  - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
  - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 23 09 23 "Direct Digital Control (DDC) System for HVAC"
  - 3. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
  - 4. Electrical Connection: 115 V, single phase, 60 Hz.
- O. Accessories:
  - 1. Keyed Auxiliary switches for position indication.
  - 2. Keyed, damper test and reset switches, remote mounted.

2.07 FLANGE CONNECTORS

- A. Description: Roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- B. Material: Galvanized steel.
- C. Gage and Shape: Match connecting ductwork.

2.08 TURNING VANES

- A. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
  - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- B. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
- D. Vane Construction: Double wall.

2.09 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Greenheck Products; a division of MESTEK, Inc.
  - 2. Ductmate Industries, Inc.
  - 3. Flexmaster U.S.A., Inc.
  - 4. Nailor Industries Inc.
  - 5. Ruskin.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
  - 1. Door:
    - a. Double wall, rectangular.
    - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
    - c. Vision panel.
    - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
    - e. Fabricate doors airtight and suitable for duct pressure class.
  - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
  - 3. Number of Hinges and Locks:
    - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
    - b. Access Doors up to 18 Inches Square: Continuous and two sash locks.
    - c. Access Doors up to 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.

- d. Access Doors Larger Than 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.
- C. Pressure Relief Access Door:
  - 1. Door and Frame Material: Galvanized sheet steel.
  - 2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
  - 3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
  - 4. Factory set at 3.0- to 8.0-inch wg.
  - 5. Doors close when pressures are within set-point range.
  - 6. Hinge: Continuous piano.
  - 7. Latches: Cam.
  - 8. Seal: Neoprene or foam rubber.
  - 9. Insulation Fill: 1-inch-thick, fibrous-glass or polystyrene-foam board.

## 2.10 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire and smoke dampers according to UL listing.
- H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
  2. Upstream and downstream from duct filters.
  3. At outdoor-air intakes and mixed-air plenums.
  4. At drain pans and seals.
  5. Downstream from control dampers, backdraft dampers, and equipment.
  6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
  7. At each change in direction and at maximum 50-foot spacing.
  8. Control devices requiring inspection.
  9. Elsewhere as indicated.
- I. Install access doors with swing against duct static pressure.
- J. Access Door Sizes:
1. One-Hand or Inspection Access: 8 by 5 inches.
  2. Two-Hand Access: 12 by 6 inches.
  3. Head and Hand Access: 18 by 10 inches.
  4. Head and Shoulders Access: 21 by 14 inches.
  5. Body Access: 25 by 14 inches.
  6. Body plus Ladder Access: 25 by 17 inches.
- K. Label access doors according to Section 23 05 53 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- L. Install flexible connectors to connect ducts to equipment.
- M. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- N. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- O. Connect flexible ducts to metal ducts with draw bands.
- P. Install duct test holes where required for testing and balancing purposes.

### 3.02 FIELD QUALITY CONTROL

- A. Tests and Inspections:
1. Operate dampers to verify full range of movement.
  2. Inspect locations of access doors and verify that purpose of access door can be performed.
  3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
  4. Inspect turning vanes for proper and secure installation.

END OF SECTION 23 33 00



## SECTION 23 33 46 - FLEXIBLE DUCTS

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes: Insulated flexible ducts.

#### 1.02 SUBMITTALS

- A. See section 230000 "General Requirements of HVAC" for submittal requirements.

### PART 2 - PRODUCTS

#### 2.01 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- C. Comply with the Air Diffusion Council's "ADC Flexible Air Duct Test Code FD 72-R1."
- D. Comply with ASTM E 96/E 96M, "Test Methods for Water Vapor Transmission of Materials."

#### 2.02 INSULATED FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Flexmaster U.S.A., Inc.
  - 2. JP Lamborn
  - 3. Hart & Cooley.
  - 4. Quietflex
- B. Insulated, Flexible Duct: UL 181, Class 1, two-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
  - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
  - 2. Maximum Air Velocity: 4000 fpm.
  - 3. Temperature Range: Minus 10 to plus 160 deg F.
  - 4. Insulation R-Value: R6.

## 2.03 FLEXIBLE DUCT CONNECTORS

- A. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install flexible ducts according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install in indoor applications only. Flexible ductwork should not be exposed to UV lighting.
- C. Connect diffusers or light troffer boots to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- D. Install duct test holes where required for testing and balancing purposes.
- E. Installation:
  - 1. Install ducts fully extended.
  - 2. Do not bend ducts across sharp corners.
  - 3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
  - 4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
  - 5. Install flexible ducts in a direct line, without sags, twists, or turns.
- F. Supporting Flexible Ducts:
  - 1. Suspend flexible ducts with bands 1-1/2 inches wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch per 12 inches.
  - 2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.
  - 3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
  - 4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches o.c.

END OF SECTION 233346

## SECTION 23 37 13 - GRILLES, REGISTERS, AND DIFFUSERS

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes:
  - 1. Grilles, Registers and Diffusers.
- B. Related Requirements:
  - 1. Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.

#### 1.02 SUBMITTALS

- A. See Section 23 00 00 "General Requirements of HVAC" for submittal requirements.

### PART 2 - PRODUCTS

#### 2.01 GRILLES, REGISTERS AND DIFFUSERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Krueger.
  - 2. Nailor Industries Inc.
  - 3. Price Industries
  - 4. Titus
- B. See the "Grilles Registers and Diffusers Schedule" on the drawings for grille, register or diffuser type, mounting, capacities, characteristics, finish, etc.
- C. Coordinate the color and finish of all grilles registers and diffusers with the architect if not specifically listed in the "Grilles Registers and Diffusers Schedule".
- D. Substituted grilles, registers and diffusers must meet or exceed the performance of the schedules diffuser.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

- A. Install grilles, registers and diffusers level and plumb.
- B. Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

- C. Install grilles, registers and diffusers with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.
- D. Provide all duct transitions and duct fittings required for a complete installation.

3.02 ADJUSTING

- A. After installation, adjust grilles, registers and diffusers to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13

SECTION 26 00 10 – GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. The requirements listed in this section are supplemental to the Division 01 General Requirements.
- B. It shall be the responsibility of the Electrical and Low-voltage Contractors to examine and refer to all Architectural, Civil, Structural, Mechanical, Plumbing and Landscape drawings and specifications for construction conditions which may affect the scope of Electrical, Communications, Electronic Safety and Security work. Inspect the building site and existing facilities for verification of present conditions. Make proper provisions for these conditions in performance of the work and cost thereof.
- C. Electrical, Communications, Electronic Safety and Security work for this project shall include all items, articles, materials and the associated labor mentioned, schedules or shown in these specifications and in the accompanying drawings.
- D. Furnish and install all equipment, materials and any required incidental items required by good practice to complete the systems described herein.
- E. Refer to Division 01 for all listed Alternates and provide separate pricing and work as indicated in Division 01 and Contract Documents.

1.02 DEFINITIONS - Throughout contract documents these words and phrases are used:

- A. Contract documents - All drawings, specifications, addenda and change orders that document work to be done.
- B. Demolition – Carefully disconnect and remove items. All reasonable caution shall be taken to avoid damaging removed equipment and to retain its operability.
- C. Remove back to source - Remove all conduit and wire back to panelboard or last live device.
- D. Equivalent or equal - Product of like type and function that complies with all applicable provisions of drawings and specifications and which has been approved as substitute for specified item.
- E. Furnish - Purchase material as shown and specified, and place material to approved location on site or elsewhere as noted or agreed upon.
- F. Install - Set in place and connect, ready for use and in complete and properly operating finished condition.
- G. Provide - Furnish and install with all products, labor, sub-contracts, and appurtenances required for a complete and properly operating, finished condition.
- H. Rough-in - Provide conduit raceway system with junction boxes, fittings, straps, BUSHINGS, etc., for future installation of wiring, devices, disconnects and breakers. Provision shall be made in panelboard (hardware, etc.) for future installation of breakers.

- I. Serviceable - Arranged so that component or product in question may be properly removed and replaced without disassembly, destruction or damage to surrounding installation.

#### 1.03 CODES, STANDARDS AND REGULATIONS

- A. Codes - Perform all work in strict accordance with all applicable national, state and local codes; including, but not limited to latest legally enacted editions of following codes:
  1. International Building Code – IBC
  2. Oregon Structural Specialty Code – OSSC
  3. NFPA 70, National Electric Code – NEC
  4. Oregon Electrical Safety Code - OESC
  5. NFPA 72, National Fire Alarm Code
  6. Oregon Fire Alarm Code – OFAC
  7. International Fire Code – IFC
  8. Oregon Fire Code - OFC
  9. International Energy Conservation Code – IECC
  10. Oregon Energy Efficiency Specialty Code – OEESC
  11. ANSI-C2, National Electrical Safety Code – NESC
- B. Standards - Reference to standards infers that installation, equipment and material shall be within limits for which it was designed, tested and approved, in conformance with current publications and standards of following organizations:
  1. American National Standards Institute – ANSI
  2. American Society for Testing and Materials – ASTM
  3. American Society of Heating Refrigerating and Air Conditioning Engineers – ASHRAE (Standard 90-75)
  4. Institute of Electrical and Electronics Engineers – IEEE
  5. Insulated Cable Engineers Association – ICEA
  6. National Electrical Contractors Association – NECA
  7. National Electrical Manufacturers' Association – NEMA
  8. National Fire Protection Association – NFPA
  9. Occupational Safety and Health Administration – OSHA
  10. Underwriters' Laboratories, Inc. – UL
  11. Rules and Regulations of the State/Local Fire Marshal
  12. Standards and Requirement of the Serving Utilities
  13. State and Local Ordinances
- C. Regulations - Design has been performed in accordance with applicable regulations and guidelines noted below. Contractor shall carefully apply these regulations and bring any discrepancies to immediate attention of Architect/Engineer.
  1. Americans with Disabilities Act – ADA

#### 1.04 FEES AND PERMITS

- A. Electrical Contractor shall pay for all permits or fees in connection with electrical work. Fees shall include any or all user fees, government fees, system development fees, connection fees or other fees that are required to be paid before systems can be connected or used.

- B. Schedule all required electrical inspections with local electrical inspector. Notify engineer of all items of discrepancy noted by electrical inspector if those items affect cost or function of system, or if they conflict with electrical drawings and specifications.
- C. All Utility Cost and fees from the utility work shall be the responsibility of the Owner. Contractor to coordinate all utility requirements, standards and responsibilities with serving utility for a complete scope of work prior to bid.
- D. Deliver all inspection certificates to Architect/Engineer prior to final acceptance of work.

1.05 INTENT OF SPECIFICATIONS AND DRAWINGS

- A. Plans and specifications are intended to result in complete electrical installation in full compliance with all applicable codes, standards and ordinances.
- B. Plans and specifications are to supplement each other and any details contained in one shall be included as if contained in both.
- C. Electrical drawings shall serve as working drawings, but Architectural drawings shall take precedence if any dimensional discrepancies exist.
- D. Drawings are partly diagrammatic and do not show routing of conduits, exact location of products, or installation features in exact detail. Locations of devices, fixtures and equipment are approximate unless dimensioned.
- E. Riser diagrams and control schematics are not to scale and do not show physical arrangement of equipment. Do not use riser diagrams or schematics to obtain lineal conduit and cabling distances.
- F. Items are shown on drawings in locations to minimize interference with other equipment, structural members, etc. Exact finish locations are not indicated, however, and all work shall be done to avoid interference, preserve headroom and keep openings and passageways clear.
- G. In event that discrepancies of any kind exist or required items/details have been omitted, Contractor shall notify Architect/Engineer in writing of such discrepancy or omission at least ten days prior to bid date. Failure to do so shall be construed as willingness of Contractor to supply all necessary materials and labor required for proper completion of work.

1.06 CONTRACTOR'S RESPONSIBILITY - Contractor shall be responsible for installation of complete and functional piece of work in accordance with true intent of contract documents. Provide all incidental items required for complete installation and satisfactory operation of all equipment, whether or not specifically noted in contract documents.

A. QUALIFICATIONS

- 1. Contractor shall employ on this project, capable, experienced and reliable foreman and such skilled workmen as may be required for various classes of work to be performed.
- 2. Where special skills and certification are required, Contractor shall ensure that work is performed by individuals with required experience, skill and certification.
- 3. If, in Engineer's opinion, Contractor's employees do not possess necessary qualifications to perform specialty work, Contractor will be required to obtain services of workmen who

are approved by manufacturer and certified by applicable agency or group. These workmen, if required, shall be provided at no additional expense.

4. Refer to other specification sections for additional required contractor qualifications and certification.

B. LICENSING AND CERTIFICATION - All Division 26 work shall be accomplished by Electricians, licensed by state in which work is being done, certified as required, and skilled in their craft. Electrician may elect to hire subcontractors for portions of work (such as systems described in Divisions 27 and 28) who are not licensed electricians, but have required certificates and are licensed in their discipline by state in which work is being done.

C. COORDINATION

1. Contractor shall consult all contract documents, shop drawings of other trades, and actual building dimensions to predetermine that his work and equipment will fit as planned. Do not scale drawings for fabrication. No extra payment will be issued for materials or items which do not fit because of Contractor's failure to verify as-built building dimensions.
2. Contractor shall check location of fixtures, outlets, equipment, conduit, etc., to determine they clear all openings, structural members, piping, ducts and miscellaneous equipment having fixed locations.
3. Changes in location of electrical work, necessary due to obstacles or installation of other trades shown on contract documents, shall be made by Electrical Contractor at no extra cost.
4. Contractor shall coordinate with Plumbing and Mechanical Contractors to avoid installation of piping and ductwork above or below panelboards in violation of National Electrical Code.
5. Lay out all work in advance and avoid conflict with other work in progress. Physical dimensions shall be determined from architectural and structural plans. Verify locations for junction boxes, disconnect switches, stub-ups, etc., for connection to equipment furnished by others, or in other Divisions of this work.
6. Contractor shall coordinate and plan work to proceed with work of other trades.
7. Contractor shall inform General Contractor of all required openings in building structure for installation of electrical equipment.
8. Contractor shall check dimensions of all electrical equipment installed, provided by himself or by others, so correct clearances and connections can be made.
9. Consulting all contract documents and shop drawings of other trades, contractor shall determine where electrical junction/pull boxes and equipment can be installed to maintain proper accessibility. Where accessibility cannot be maintained by judicious placement of boxes, Electrical Contractor shall coordinate with General Contractor to provide, fabricate, install, adjust, paint, etc. access doors through non-accessible floor, wall, and ceiling finishes to allow access to all electrical junction and pull boxes, electrical devices, electrical equipment, etc. at all required locations whether shown or not shown on plans. Electrical Contractor is responsible for determining size and location of the access doors. Report any conflicts to Architect/Engineer.

1.07 REVIEW

- A. All work and material is subject to review at any time by the Architect/Engineer or his representative. If the Architect/Engineer or his representative finds material that does not conform to these specifications or that is not properly installed or finished, correct the deficiencies in a manner satisfactory to the Architect/Engineer at the Contractor's expense.



1.08 TEMPORARY FACILITIES

A. ELECTRICAL UTILITIES

1. The Electrical Contractor shall provide temporary electrical power to the construction site as directed by the General Contractor. No connections to the owner's system shall be allowed without owner's written approval. Provide a separate utility service as required.
2. The Electrical Contractor shall provide temporary electrical power to job trailers as directed by the General Contractor.
3. The Electrical Contractor shall provide temporary communications to job trailers as directed by the General Contractor.
4. All Costs associated with temporary power, communications and utility cost shall be paid by to the General Contractor.
5. The Electrical Contractor shall provide temporary construction lighting as directed by the General Contractor to provide a safe working environment.
6. All temporary services are to be removed in their entirety prior to occupancy as directed by the General Contractor.

B. OFFICES

1. The Electrical Contractor must have the permission of the Owner and General Contractor or Construction Manager to install a temporary office/job trailer on the project site.
2. Contractor shall completely remove his temporary installations when no longer needed and the premises shall be completely clean, disinfected, patched, and refinished to match adjacent areas.

C. LADDERS AND SCAFFOLDS

1. The Electrical and Low-voltage Contractors shall provide their own ladders, scaffolds, etc. of substantial construction for access to their work in various portions of the building as may be required. When no longer needed, they shall be removed by the Contractor.

D. PROTECTION DEVICES

1. The Electrical and Low-voltage Contractors shall provide and maintain their own necessary barricades, fences, signal lights, etc., required by all governing authorities or shown on the drawings. When no longer needed, they shall be removed by the Contractor.

E. TEMPORARY FIRE PROTECTION

1. The Electrical and Low-voltage Contractors shall provide all necessary first aid hand fire extinguishers for Class A, B, C and special hazards as may exist in his own work area only in accordance with good and safe practice and as required by jurisdictional safety authority.

1.09 RECORD DOCUMENTS (AS-BUILT DRAWINGS)

- A. See requirements regarding record documents in General Division and Division 1.
- B. At beginning of work, Contractor shall set aside one complete set of drawings which shall be maintained as complete "As-Built" set. Drawings shall be updated daily in neat and legible manner and shall not be used for any other purpose. Drawings, specification, addenda, change orders, etc. shall be maintained at job site and available for review at any time.

- C. Show dimensioned location and routing of all electrical work that will become permanently concealed, cast in concrete or buried underground.
- D. Show complete routing and sizing of any significant revisions to systems shown.
- E. Show provisions for future connection, referenced to building lines or approved bench marks.
- F. Provide wiring diagrams for all individual communications systems as installed. Identify all components and show all wire and terminal numbers and connections.
- G. At completion of project, deliver drawings to Engineer for review.

#### 1.10 WARRANTY

- A. The Contractor shall guarantee that all materials and labor installed are new and of first quality and that any material or labor found defective shall be replaced without cost to the Owner within one (1) year after substantial completion of the Contract or one (1) full season of heating and cooling operation, whichever is the greater. The guarantee shall list the date of the beginning of the one (1) year period, which shall be the date that the Substantial Completion Certificate is issued.
- B. Any damage to the building, caused by defective work or material of the Contractor within the above-mentioned period, shall be satisfactorily repaired without cost to the Owner.
- C. The guarantee does not include maintenance of equipment. The Owner shall accept full responsibility for proper operation and maintenance of equipment immediately upon substantial completion and occupancy of the building.
- D. Final acceptance by the Owner will not occur until all operating instructions are mounted in Equipment Rooms and Operating Personnel thoroughly indoctrinated in the operation of all electrical equipment by the Contractor.
- E. No equipment installed as part of this project shall be used for temporary heat during construction.

### PART 2 - PRODUCTS

#### 2.01 MATERIALS AND EQUIPMENT

- A. Manufacturer's trade names and catalog numbers listed are intended to indicate the quality of equipment or materials desired. Manufacturers not listed in the specification will be considered substitutions and must have prior approval.
- B. See Division 01 for Substitutions Procedures. Requests for substitution are to be submitted sufficiently ahead of the deadline, to give ample time for examination. Prior approval request for substitution must indicate the specific item or items to be furnished in lieu of those scheduled, together with complete technical and comparative data on scheduled items and items proposed for substitution.
- C. If the engineer approves any proposed substitution, the approved product will be listed in an addendum. Bidders shall not rely on approval made in any other manner.

- D. Electrical equipment may be installed with manufacturer's standard finish and color except where specific color, finish or choice is indicated. If the manufacturer has no standard finish, equipment shall have a prime coat and two finish coats of gray enamel.
  - E. High altitude operation: Capacity of all equipment is to be sized and manufactured to perform at the elevation of the project site. If not specifically indicated in the equipment schedule or in the specifications provide all required accessories and equipment for proper operation at elevation of the project site.
  - F. This Contractor shall be responsible for materials and equipment installed under this contract. Contractor shall also be responsible for the protection of materials and equipment of others from damage as a result of his work.
  - G. Manufactured material and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by manufacturer unless herein specified to the contrary.
  - H. This Contractor shall make the required arrangement with General Contractor or Construction Manager for the introduction into the building of equipment too large to pass through finished openings.
  - I. Store materials and equipment indoors at the job site or, if this is not possible, store on raised platforms and protect from the weather by means of waterproof covers. Coverings shall permit circulation of air around the materials to prevent condensation of moisture. Screen or cap openings in equipment to prevent the entry of vermin.
- 2.02 SUBSTITUTION OF MATERIALS - Where substituted equipment requires structural, architectural, mechanical, plumbing or electrical work that differs from basic design, cost of all changes, including re-design, shall be responsibility of contractor using substitution.
- A. APPROVED MANUFACTURERS
    - 1. In general, one particular manufacturer and part number or series is listed to describe equipment. Equivalent equipment of other manufacturers listed for that item may be substituted without prior approval. It shall be Contractor's responsibility to ensure that item used for bidding purposes is truly equivalent to that specified. If it is not equivalent, it will be rejected at shop drawing review and Contractor shall supply specified item at his own cost.
    - 2. It is understood that manufacturers listed may not actually have equivalent product to that specified. If contractor/distributor has any questions regarding desired product characteristics and suitability of proposed substitution, he is encouraged to submit for prior approval. Also, any manufacturer not listed shall be submitted for prior approval.
  - B. PRIOR APPROVALS
    - 1. Manufacturers not listed in specification or on schedule for a particular item are open for substitution prior to bid opening only.
    - 2. Manufacturers desiring approval shall submit catalog cuts that define quality of product and ability to perform as specified. It is understood that no two manufactures use identical methods or make identical products. Any and all deviations from that specified shall be clearly noted.
    - 3. Submittals shall arrive at Engineer at least ten (10) days prior to bid opening. All approvals will be listed in last addendum as being approved to bid. Items substituted, but not listed in contract documents, will not be considered if submitted on shop drawings.

4. Approval of substitute equipment is on basis of quality only. Materials supplier shall be responsible for his quotation reflecting proper selection of his particular equipment with regard to proper capacities, physical dimensions, requirements, intended function, finish, color, etc. Engineer will not give approval to specific model numbers or check capacities, dimensions, or requirements. Evaluation will be on basis of quality and equality to specified items.
5. Prior approval shall be obtained from engineer and no other entity (architect, owner, etc.) is authorized to give such approval.

C. SAMPLES

1. Where, in Engineer/Architect's opinion, product sample is required in order to determine appearance, quality, workmanship or operation, Contractor shall submit actual production samples of item in question.
2. Samples will be returned to Contractor. Approved samples may be used.
3. All costs incurred in providing and returning samples will be Contractor's responsibility.

2.03 PRODUCT AND SYSTEM SUBMITTALS

- A. Submittals will be required for each piece of equipment, material or product as noted in the table below. All submittal shall be submitted, reviewed and all discrepancies addressed prior to ordering equipment or starting work. Any equipment ordered without having first completed the submittal process is done at the risk of the contractor. Any work performed prior to completing the submittal process is done at the risk of the contractor.

B. SUBMITTAL DEFINITIONS

1. Product Data: Provide manufacturers cut sheets that include general product information including but not limited to: Model Number, physical data, nominal capacities, rough-in requirements.
2. Performance Data: Provide detailed performance and capacities based on project specific requirements including but not limited to: voltage, phase, amperage, overcurrent protection, conductor size, conductor material, conduit size, color temperature, color rendering index, life expectancy, efficacy, efficiency, IP ratings, light distribution types and lighting control.
3. Shop Drawings: Provide detailed drawings of the equipment showing overall dimensions, location of electrical connection, location of anchorage points, location of electrical and control panels, and all operating, service and maintenance clearances.
4. Delegated Design: Provide detailed drawings prepared and stamped by a registered Professional Engineer that detail pertinent design criteria, the materials and products to be installed and the required installation locations.
5. Wiring Diagram: Provide diagrams that identify and detail required field wiring.
6. Color Chart: Provide a physical color chart of material samples required for selection of equipment colors.
7. Sustainability Compliance: Provide literature that indicated a products compliance with LEED or Green Globes. See Division 01 for additional information and requirements.

C. SUBMITTAL FORMATS

1. Include the following information with each submittal:
  - a. Project Name
  - b. Submittal Date
  - c. Name of Architect

- d. Name of Engineer
  - e. Name of General Contractor or Construction Manager
  - f. Name of Sub-Contractor
  - g. Name of firm or entity that prepared the submittal
  - h. Unique Submittal Number
  - i. Type of Submittal
  - j. Specification Section
  - k. Name or Mark of equipment or material and detail or drawings reference.
2. All Submittal with the exception of color charts or material samples shall be electronically transmitted PDFs. All submittals over 8 Mb shall be setup on a share file site and access granted through email with folder's link for download.

D. SUBMITTAL REQUIREMENTS

1. Submittals shall be submitted as a complete specification section. The submittal must include all materials and equipment for that specification section. Submittals for individual materials of equipment will be rejected without review.
  2. Submittals shall be complete, clearly show item used, size, dimensions, capacity, rough in, etc., as required for complete check and installation. Manufacturer's literature showing more than one item shall be clearly marked as to which item is being furnished or it will be rejected and returned without review.
  3. Each submittal shall be thoroughly checked by the Contractor for compliance with the Contract Document requirements, accuracy of dimensions, relationship to the work of other trades, and conformance with sound, safe practices as to erection and installation. Each submittal shall then bear a stamp evidencing such checking and shall show corrections made, if any. Submittals requiring extensive corrections shall be revised before submission. Each submittal not stamped and signed by the General and Electrical Contractors evidencing such checking will be rejected and returned without review.
  4. 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 on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
  5. Review of the shop drawings and literature by the engineer shall not relieve the contractor for responsibility for deviations for the drawings or specifications, nor shall it relieve the contractor from responsibility for errors in the shop drawings or literature. It is the responsibility of the contractor to provide materials and equipment which meet the specifications and job requirements.
  6. Luminaires submittals shall include dimensions, quality, distribution, color rendering index, color temperature, optics, photometrics, all listings (UL, DLC, Energy Star, Made in America, etc.), IP ratings, voltage, wattage, warranty, installation methods, control methods, efficacy, efficiency, diffuser options, emergency operation and any required accessories. Provide IES and Revit files upon request.
- E. ENGINEER'S REVIEW - Submittal review is for general design and arrangement only and does not relieve Contractor from any requirements of contract documents. Submittals will not be checked for quantity, dimension, fit or proper technical design of manufactured equipment. Where product or system performance deviations have not been specifically noted in submittal by Contractor, Engineer's review will not relieve Contractor's responsibility to provide complete and satisfactory working installation of equal quality and performance to specified system. Ordering, manufacture, shipment or installation of equipment prior to receipt of Engineer's written review is strictly at Contractor's risk and all costs associated with shipping, changes, replacement or restocking shall be Contractor's responsibility.

- 2.04 SUB-CONTRACTORS - With shop drawing submittals, Contractor shall submit list of all sub-contractors to be used for the project.
- 2.05 OPERATION AND MAINTENANCE MANUALS
- A. Operation and Maintenance Manuals (O&M Manuals) shall contain:
1. Names and contact information for the Project Architect, Project Engineer.
  2. Names and contact information for the General Contractor or Construction Manager.
  3. Names and contact information for sub-contractors.
  4. Installation, maintenance and operating instructions for each piece of equipment.
  5. Parts lists
  6. Wiring Diagrams
  7. Equipment Start-up and inspection certificates
  8. Test and Balance Reports
  9. Commissioning Reports
  10. Copies of Equipment Warranties
  11. Copies of Submittals
  12. Record Drawings.
  13. Training DVD's.
- B. Prior to substantial completion submit an electronic copy of the O&M manual in PDF format to the Architect, Engineer and Owner for Review and approval. The PDF shall be one file with an index and hyperlinks to each section. Individual bound PDFs without automated navigation will be rejected. All O&M data shall be grouped by the equipment type and ordered by the specification numbering.
- C. Prior to final payment a final electronic copy of the O&M manual on an archival quality DVD as well as two printed copies shall be furnished to the owner. Printed copies shall have commercial quality 8-1/2" x 11" 3-ring binders with tabbed dividers for each section.

### PART 3 - EXECUTION

#### 3.01 SITE EXAMINATION

- A. Prior to submitting bid, Contractor shall visit site of proposed work and familiarize himself with conditions affecting work. Allowance shall be made in bid for these conditions and no additional allowance shall be granted because of lack of knowledge of such conditions.
- B. Contractor shall verify all measurements at building site.

#### 3.02 CUTTING AND PATCHING

- A. Obtain written permission of Architect/Engineer before cutting or piercing structural members.
- B. Sleeves through floors and walls shall be black iron pipe, flush with walls, ceilings or finished floors, sized to accommodate raceway. Grout all penetrations through concrete walls or floors. Holes through existing concrete and concrete block (CMU) shall be core drilled.

3.03 CLEAN-UP AND COMMISSIONING

- A. DURING CONSTRUCTION - Throughout construction, keep work area reasonably neat and orderly by periodic clean-ups.
- B. COMMISSIONING - As independent parts of construction are completed, they may be commissioned and utilized during construction. See various sections for restrictions.
- C. AT COMPLETION OF WORK
  - 1. Clean equipment of dirt and debris, including interior of panels, outlet boxes, etc. Remove labels from and clean all fixture lenses.
  - 2. Remove materials, scraps, etc., relative to this work and leave premises in clean and orderly condition. This includes all tunnels, attics, ceiling and crawl spaces.
  - 3. Remove all temporary facilities and restore to conditions present prior to work.

3.04 PROJECT COMPLETION AND DEMONSTRATION

- A. TESTING
  - 1. Prior to final test, all switches, panelboards, devices, and fixtures shall be in place.
  - 2. At completion of work, or upon request from Architect/Engineer, place entire electrical installation, and/or any portion thereof, in operation to demonstrate satisfactory operation.
  - 3. All electrical systems shall be free from short circuits and unintentional grounds.
  - 4. Furnish one (1) copy of certified test results to Architect/Engineer prior to final inspection and include one (1) copy in each Brochure of Equipment.
- B. ADJUSTMENTS
  - 1. Make all changes necessary to balance connected electrical loads on complete system. Arrange for balanced conditions of circuits under connected load demands, as contemplated by normal working conditions. Final load and balance test shall be demonstrated in presence of Architect/Engineer.
  - 2. Immediately correct all deficiencies which are evidenced during tests and repeat tests until system is approved. Do not cover or conceal electrical installations until satisfactory tests are made and approved.
- C. FINAL WALK-THRU
  - 1. Conduct operating tests during final inspection. Demonstrate installation to operate satisfactorily in accordance with requirements of Contract Documents. Should any portion of installation fail to meet requirements of Contract Documents, repair or replace items failing to meet requirements until items can be demonstrated to comply.
  - 2. Have instruments available for measuring light intensities, voltage and current values and for demonstration of continuity, grounds, or open circuit conditions.
  - 3. Furnish personnel to assist in taking measurements and making tests. In event that systems are not complete and fully operational at time of final inspection, all costs of any subsequent inspections shall be borne by Contractor at no additional cost to Owner.

3.05 OWNER ORIENTATION AND TRAINING

- A. GENERAL
  - 1. The system training is intended to familiarize the Owner's operating and maintenance staff with all systems requiring maintenance. Training is to be provided after the systems

- are in place and operational, after issues noted during commissioning have been resolved, and before final acceptance.
2. Provide second set of training sessions for automatic control systems about 6-9 months after the first sessions.
  3. All Training shall be videotaped and reproduced on DVD's and given to the owner. Provide a copy for each O&M manual produced.
  4. See Individual specification sections for additional training requirements.
- B. ATTENDANCE
1. Training is to be provided by contractor's representatives that are familiar with the system's operation and maintenance requirements. Individual training sessions (modules) are to be provided for each type or group of systems, separated roughly by trade group that will be performing maintenance on the system.
- C. SCHEDULE
1. Duplicate training sessions are to be provided for each training module, so that Owner's operating personnel can be split into two groups during training. Duplicate training sessions to be scheduled on different days. Length of training sessions will be determined by scope of training indicated below, and as coordinated with Owner after draft copy of training documents have been reviewed.
- D. TRAINING DOCUMENTATION
1. Contractor to submit draft copy of agenda and training documents to Owner for review at least two weeks prior to training date.
  2. Provide a copy of the following items for each person that will be attending the training sessions. Coordinate required number with the Owner.
    - a. Training agenda.
    - b. Summary of new systems and existing systems affected by this project.
    - c. Summary of work performed under this project.
    - d. Control system drawings and sequences of operation.
    - e. List of important maintenance and trouble-shooting operations for all systems.
  3. Provide minimum of 2 copies of following items:
    - a. Contract documents including all drawings, specifications, addendums, and change orders.
- E. TRAINING SESSIONS
1. Assemble at location to be determined by the Owner.
  2. Distribute training documentation as indicated above.
  3. Provide classroom style training if required for orientation, discussion of new systems and existing systems affected by this project, and other issues appropriate for a classroom format.
  4. Visit site and review locations, and perform detailed review of operation and maintenance requirements for current systems.
  5. All training session shall be video recorded and distributed to the owner upon completion in DVD format, or owner desired format. Include all training videos in the O&M manual.

END OF SECTION 26 00 10



SECTION 26 05 05 - SELECTIVE DEMOLITION OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. This section describes general requirements and methods of execution relating to selective demolition of electrical systems.
- B. Not all removal and revision work required as part of the demolition work is shown on the plans. The plans are intended to indicate areas where demolition will occur and to establish the intent of the demolition work. It is the Contractor's responsibility to remove all existing electrical raceways, wires, devices and equipment that fall within the area affected by demolition of the structure.
- C. The Contractor shall thoroughly familiarize himself with work and local conditions under which the work is to be performed. Using original design drawings and walk-through inspections, a concerted effort was made to place pertinent information on contract drawings. However, due to nature of demo/remodel work, the Contractor must bear in mind that unforeseen conditions may exist, and shall thoroughly inspect work area prior to his bid. The Contractor shall include in his bid any incidental items which may be required to provide complete demolition and rework associated systems in adjacent areas where no demolition is occurring.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Provide materials in accordance with applicable sections in these specifications where:
  - 1. Additional conduit, fittings, conductors, etc., are required for re-connection of circuits that extend beyond the demolition area.
  - 2. Devices or equipment need to be temporarily or permanently relocated.
  - 3. Portions of the remaining structure need to be patched or resurfaced.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify field measurements and circuiting arrangements as shown on Drawings.
- B. Verify that raceways, wiring and equipment being demo'ed only serve facilities in the designated demolition area.
- C. Examine existing light fixtures being removed to verify if ballasts contain PCB's.

3.02 PREPARATION

- A. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations and follow the safe working practice requirements of NFPA 70E.
- B. PRE-DEMOLITION MEETING - Participate in a pre-demolition meeting at the project site with Owner and all affected stakeholders.
  - 1. Inspect and discuss the condition of construction to be selectively demolished.
  - 2. Review all asbestos reports and plan electrical demo work to comply with report findings.
  - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
  - 4. Review and coordinate requirements of work performed by other trades.
  - 5. Review areas where existing construction is to remain and requires protection.
  - 6. Review procedures to be followed when critical systems are inadvertently interrupted. The Contractor shall be responsible for the coordination required with Owner prior to device/system removal to ensure systems that must remain operational are not compromised during the demolition process.
- C. SURVEY OF EXISTING CONDITIONS - Record existing conditions by use of preconstruction photographs or video.
  - 1. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
  - 2. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.
- D. EXISTING ELECTRICAL SERVICE
  - 1. Make provisions to maintain existing power system in service until new system is complete and ready for use.
  - 2. Disable the power system only to make switchovers and connections.
  - 3. Obtain permission from the Owner and the Architect/Engineer at least [48] hours prior to partially or completely disabling the system.
  - 4. Minimize the duration of any outages.
  - 5. If required, make temporary connections to maintain service in areas adjacent to the demolition work area.

3.03 COORDINATION

- A. The Contractor is responsible for providing and coordinating phased activities and construction methods that minimize disruption to facility operations. Ensure that any portion of systems or devices to remain continue to be complete and operational. Equipment and devices shall not be removed or reconfigured until coordinated with owner.
- B. The Contractor shall coordinate interfaces to existing systems that are being demolished in order to minimize disruption to the existing systems operations. Coordinate all utility service and system outages with the Owner's Representative, the Architect/Engineer and the local Utility Company as applicable.

- C. Demolition and remodel shall be done quickly so as to not hinder other trades.
  - D. Refer to demolition drawings, new drawings and site drawings to coordinate demolition and remodel efforts. Notify Architect/Engineer of any discrepancies.
- 3.04 EXISTING SERVICES/SYSTEMS TO REMAIN - Maintain services/systems indicated to remain and protect them against damage.
- A. Comply with requirements for existing services/systems interruptions.
  - B. When temporary bypass systems are installed, test and get approval from Engineer before proceeding with demolition of existing systems.
  - C. For existing equipment cabinets with active components in them, provide an air tight dust seal around the cabinet and circulate cooling air with a portable air conditioning unit or other means to ensure equipment does not overheat.
- 3.05 DEMOLITION
- A. Revise electrical connections as required to remove all equipment and items listed herein or shown on plans. Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations
  - B. Remove all electrical devices from walls, floors and ceilings that are to be demolished or moved. This includes but is not limited to:
    - 1. Abandoned panelboards and distribution equipment along with the conduits and wires that constitute their feeders.
    - 2. Starters, disconnects and other devices and equipment serving utilization equipment that is being removed.
    - 3. Light fixtures including brackets, stems, hangers, and other accessories.
    - 4. Switches, outlets, horns, bells, intercom stations, clocks, etc.
  - C. Remove abandoned outlets if conduit and wiring servicing them is abandoned and removed. Provide blank cover for any abandoned boxes which are noted on the plans as not removed.
  - D. Remove conduit to point where it no longer interferes with construction and is concealed. For conduit buried in concrete or CMU walls, cut conduit off flush with floor and plug conduit.
  - E. If certain conduits and boxes are abandoned but not scheduled for removal, they shall be shown on the "As Built Drawings".
  - F. If the plans specifically call for conduits that are routed through the demolition area, and are to remain, provide supplemental support to meet the requirements in:
    - 1. Section 260529 "Hangers and Supports for Electrical Systems."
    - 2. Section 260533 "Raceways and Boxes for Electrical Systems."
    - 3. Section 260548.16 "Seismic Controls for Electrical Systems."
  - G. Remove all conductors back to source (panelboard or last live device). Remove all abandoned communications and security systems cable from origin to destination (do not abandon in place UNO).

- H. Contractor shall give Owner option to keep demo'd electrical items of his choice. Contractor is responsible for disposal of all remaining electrical items.
- I. Contractor shall be responsible for disposal of all removed lamps and ballasts. Ballasts may contain PCB's and lamps may contain Mercury. These shall be disposed of according to environmental regulations.
- J. Provide revised typed circuit directory in panelboards that have circuits removed.
- K. Repair adjacent construction and finishes damaged during demolition and extension work.
- L. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.
- M. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover any openings to remain.
- N. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
- O. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and/or portable fire suppression devices during flame-cutting operations.
- P. Maintain adequate ventilation when using cutting torches.
- Q. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- R. Dispose of demolished items and materials promptly.

### 3.06 RELOCATION OF EXISTING EQUIPMENT

- A. Equipment to be relocated shall be serviced, modified and repaired as necessary to place it in good working order and to satisfaction of Architect/Engineer.
- B. Pack or crate items after cleaning and repairing. Identify contents of containers.
- C. Protect items from damage during transport and storage.
- D. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make the item functional for use at its new location.
- E. Equipment shall be tested in the new location and proper function demonstrated.

### 3.07 HANDLING OF BALLASTS WITH PCBs - Generally, all high power factor fluorescent light ballasts manufactured before 1978 and some HID ballasts contain polychlorinated biphenyl

(PCB) compounds in their capacitors. The Contractor shall inspect all ballasts in all light fixtures and take the actions described below:

- A. The disposal of all ballasts labeled as "NON-PCBs" or "NO PCBs" shall become the responsibility of the Contractor. If the PCB content is not stated on the ballast label, the ballast shall be handled as a PCB ballast.
- B. All PCB ballasts shall be removed from the light fixtures and shall have the wires clipped off. However, before removal, all PCB ballasts shall be carefully inspected for leaks. If a ballast appears to be leaking (evidenced by potting compound leaking out or by an oily film on the ballast surface) the ballast must be handled per EPA and DNR PCB regulations. Basically, this means the ballast is to be carefully removed from the fixture and placed in an approved drum as noted below. The person removing the ballast from the fixture shall wear protective gloves, eye protection, and protective clothing as necessary.
- C. If the fixture has also been contaminated, it must be cleaned to less than 10 micrograms/100 square centimeters contamination before disposal. Contact Architect/Engineer as this cleaning must be done by an approved PCB contractor and is not considered part of this contract.
- D. The PCB ballasts shall then be placed in US DOT approved drums (barrels). The quantity and size of the drums will be determined by the contractor at the time of construction, 30 and 55 gallon drums are typically available.
- E. PCB BALLASTS ARE NOT TO BE REMOVED FROM THE WORK SITE BY THE CONTRACTOR. To do so would be a violation of DNR and DOT hazardous waste regulations and may result in a fine to the Contractor.
- F. The Contractor shall label and mark the PCB storage drums with EPA approved PCB labels and the storage area with signs, marks and lines.
- G. The Contractor shall also provide approved PCB absorbent materials to be stored immediately adjacent to the drum storage area. Do not place loose absorbent material in the drums.

### 3.08 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
  - 1. Do not allow demolished materials to accumulate on-site.
  - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
  - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

### 3.09 LAMP DISPOSAL

- A. All lamps contain mercury and/or lead, as well as other heavy metals and compounds which are regulated by the EPA. As a result, regulations have been issued covering the handling and

disposal of all lamps. Lamps which have been removed from service for disposal shall be handled as follows by the Contractor:

1. The Contractor shall very carefully remove all lamps (fluorescent, incandescent, and HID) from light fixtures before removal of the fixture from its mounted position. This is to reduce the likelihood that the lamps will be broken.
2. All fluorescent, neon, mercury vapor, high pressure sodium, and metal halide lamps shall be recycled in accordance with Administrative Rules of Montana ARM 17.53.1303 by either working with a certified recycler from this list: [https://deq.mt.gov/Portals/112/Land/hazwaste/documents/HAZ\\_Lamp\\_Recycler\\_Lst.pdf](https://deq.mt.gov/Portals/112/Land/hazwaste/documents/HAZ_Lamp_Recycler_Lst.pdf), or by becoming a small quantity handler of universal waste in accordance with 40 CFR 273. In either case, the contractor shall be responsible for storing, labeling, shipping and training workers in accordance with 40 CFR 273. Include recycling receipts in O&M Manuals at the completion of the project.

### 3.10 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition existing before demolition operations began.
- B. The contractor shall be required, on a daily basis, to dispose of any demolished material not required to be returned to the Owner. All materials shall be transported off of the Owner's property at the expense of the Contractor.
- C. At the end of each work day or shift, the Contractor shall be required to clean up the work area and remove all construction debris such that the site is clean and usable without hazard to workers.

END OF SECTION 26 05 05

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
  - 1. Copper building wire rated 600 V or less.
  - 2. Metal-clad cable, Type MC, rated 600 V or less.
  - 3. Connectors, splices, and terminations rated 600 V and less.
- B. Related Requirements:
  - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.01 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Alcan Products Corporation; Alcan Cable Division.
  - 2. Alpha Wire Company.
  - 3. Belden Inc.
  - 4. Cerro Wire LLC.
  - 5. Encore Wire Corporation.
  - 6. General Cable Technologies Corporation.
  - 7. Okonite Company.
  - 8. Service Wire Co.
  - 9. Southwire Incorporated.
  - 10. WESCO
- C. Standards:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  - 2. RoHS compliant.
  - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

- D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- E. Conductor Insulation:
  - 1. Type USE-2 and Type SE: Comply with UL 854.
  - 2. Type THHN and Type THWN-2: Comply with UL 83.
  - 3. Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
  - 4. Type XHHW-2: Comply with UL 44.

## 2.02 METAL-CLAD CABLE, TYPE MC

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
- B. Approved for lighting whips 6' or less.
- C. Approved for installation into existing walls.
- D. 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. AFC Cable Systems.
  - 2. Alpha Wire Company.
  - 3. Belden Inc.
  - 4. Encore Wire Corporation.
  - 5. General Cable Technologies Corporation.
  - 6. Okonite Company.
  - 7. Service Wire Co.
  - 8. Southwire Incorporated.
  - 9. WESCO
- E. Standards:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  - 2. Comply with UL 1569.
- F. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- G. Conductors:
  - 1. Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
  - 2. Maximum size wire: #10 AWG.
- H. Ground Conductor: Insulated.
- I. Conductor Insulation:
  - 1. Type TFN/THHN/THWN-2: Comply with UL 83.
- J. Armor: Steel, interlocked.
- K. Jacket: PVC applied over armor for mechanical connection or wet/damp environments



2.03 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. 3M Electrical Products
  - 2. AFC Cable Systems, Inc.
  - 3. Gardner Bender.
  - 4. Hubbell Power Systems, Inc.
  - 5. Ideal Industries, Inc.
  - 6. Ilsco; a branch of Bardes Corporation.
  - 7. NSi Industries LLC.
  - 8. O-Z/Gedney; a brand of the EGS Electrical Group.
  - 9. Service Wire Co.
  - 10. TE Connectivity Ltd.
  - 11. Thomas and Betts Corp

PART 3 - EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders and Branch Circuits: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Feeders: Copper for feeds smaller than [100 A][200 A]; copper or aluminum for feeders [100 A][200 A] and larger. Conductors shall be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance:
  - 1. Type THHN/THWN-2, single conductors in raceway.
- B. Feeders:
  - 1. Type THHN/THWN-2, single conductors in raceway.
  - 2. Metal-clad cable, Type MC.
- C. Branch Circuits:
  - 1. Type THHN/THWN-2, single conductors in raceway.
- D. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.03 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 26 05 33 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 26 05 29 "Hangers and Supports for Electrical Systems."
- G. Provide a dedicated neutral conductor for each 120 V branch circuit.

3.04 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.05 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 26 05 53 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.06 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

END OF SECTION 26 05 19

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. RATIONALE – Grounding provides the foundation to the entire electrical system. This system is designed to:
- B. Protect personnel.
- C. Minimize damage to equipment and property in the event of high fault current situations,
- D. Improve overall electrical system reliability, and
- E. Minimize the effects of transient overvoltages.
- F. Section includes grounding and bonding systems and equipment.
- G. Section includes grounding and bonding systems and equipment, plus the following special applications:
  - 1. Underground distribution grounding.
  - 2. Foundation steel electrodes.

1.03 ACTION SUBMITTALS

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

1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article.
  - 1. Ground rods
- B. Qualification Data: For testing agency and testing agency's field supervisor.
- C. Field quality-control reports.
- D. Photographs of ground rod installation prior to burial.
- E. Photographs of Cadweld connections to rebar and building steel.
- F. Photographs of connection to water service and all bonding jumpers.

- G. Certified test results from ground resistance measurements.

## PART 2 - PRODUCTS

### 2.01 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

### 2.02 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Equipment and wiring device grounding conductor shall be as follows:
  - 1. Bare copper or have green insulation of same type as circuit conductors (larger wires may be permanently marked with green).
  - 2. Properly sized in accordance with the NEC.
- C. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.
  - 3. Tinned Conductors: ASTM B 33.
  - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
  - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
  - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
- D. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

### 2.03 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
  - 1. Pipe Connectors: Clamp type, sized for pipe.

- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- E. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- F. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- G. Conduit Hubs: Mechanical type, terminal with threaded hub.
- H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- I. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
- J. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.
- K. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.
- L. Straps: Solid copper, copper lugs. Rated for 600 A.
- M. Tower Ground Clamps: Mechanical type, copper or copper alloy, terminal one-piece clamp.
- N. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- O. Water Pipe Clamps:
  - 1. Mechanical type, two pieces with zinc-plated bolts.
    - a. Material: Die-cast zinc alloy.
    - b. Listed for direct burial.

## 2.04 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet (19 mm by 3 m).

## PART 3 - EXECUTION

### 3.01 APPLICATIONS

- A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
  - 1. Bury at least 24 inches (600 mm) below grade.
- C. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.

D. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.
5. Any threaded bolt connectors shall be torqued in accordance with manufacturer's guidelines.

3.02 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.03 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits. Do not rely on conduit for the grounding path.
- B. Multiple circuits sharing a raceway may share a single grounding conductor if all of the following requirements are met:
1. All circuits originate in the same panel.
  2. No more than three single pole circuits may share a ground conductor.
  3. Size the ground conductor for the largest circuit.
- C. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
1. Retain applicable subparagraphs below.
  2. Feeders and branch circuits.
  3. Lighting circuits.
  4. Receptacle circuits.
  5. Single-phase motor and appliance branch circuits.
  6. Three-phase motor and appliance branch circuits.
  7. Flexible raceway runs.
  8. Armored and metal-clad cable runs.
- D. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- E. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

3.04 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.
  - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
  - 2. For grounding electrode system, install at least 2 rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
  - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- D. Grounding and Bonding for Piping:
  - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
  - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
  - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity. Size bonding conductors and jumpers in accordance with NEC 250.122, using the rating of the circuit that is likely to energize the ducts.
- F. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, and as detailed on drawings. If drawing does not provide Ufer ground detail install the grounding electrode as defined below:
  - 1. Use a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 4 AWG.
  - 2. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within base of foundation.
  - 3. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.



- G. Structural Steel: When available, bond structural steel to grounding electrode system, according to NFPA 70.

### 3.05 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
  - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
  - 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
    - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    - b. Perform tests by fall-of-potential method according to IEEE 81.
  - 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed 25 ohms to ground.
- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
  - 1. Steel slotted support systems.
  - 2. Conduit and cable support devices.
  - 3. Support for conductors in vertical conduit.
  - 4. Structural steel for fabricated supports and restraints.
  - 5. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
  - 6. Fabricated metal equipment support assemblies.
- B. Related Requirements:
  - 1. Section 26 05 48.16 "Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.02 ACTION SUBMITTALS

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

1.03 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Data: Certificates, for hangers and supports for electrical equipment and systems, accessories, and components, from manufacturer.

1.04 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified and the supported equipment and systems will be fully operational after the seismic event."

2.02 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch- (10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.
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. Allied Tube & Conduit; a part of Atkore International.
    - b. B-line, an Eaton business.
    - c. ERICO International Corporation.
    - d. Flex-Strut Inc.
    - e. Gripple Inc.
    - f. G-Strut.
    - g. Thomas & Betts Corporation; A Member of the ABB Group.
    - h. Unistrut; Part of Atkore International.
  2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
  3. Material for Channel, Fittings, and Accessories: Galvanized steel.
  4. Channel Width: Selected for applicable load criteria.
  5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
  7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
  2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
  3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
  4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
  5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

## 2.03 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

## PART 3 - EXECUTION

### 3.01 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
  1. NECA 1.
  2. NECA 101
  3. NECA 102.
  4. NECA 105.
  5. NECA 111.
- B. Comply with requirements for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for raceways and boxes specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

### 3.02 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC and RMC may be supported by openings through structure members, according to NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum

static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
1. To Wood: Fasten with lag screws or through bolts.
  2. To New Concrete: Bolt to concrete inserts.
  3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  4. To Existing Concrete: Expansion anchor fasteners.
  5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
  6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
  7. To Light Steel: Sheet metal screws.
  8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

### 3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS D1.1/D1.1M.

### 3.04 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete.
- C. Anchor equipment to concrete base.
1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  2. Install anchor bolts to elevations required for proper attachment to supported equipment.
  3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

END OF SECTION 26 05 29

SECTION 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: scs
  1. Metal conduits and fittings.
  2. Nonmetallic conduits and fittings.
  3. Metal wireways and auxiliary gutters.
  4. Surface raceways.
  5. Boxes, enclosures, and cabinets.
  6. Handholes for exterior underground cabling.

1.02 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. For custom enclosures and cabinets include plans, elevations, sections, details, and attachments to other work.
- C. For duct banks and conduit in shared trenches submit coordination drawings showing duct profiles and coordination with other utilities and underground structures, including but not limited to scaled drawings of plans and sections showing bends and locations of expansion fittings.

1.03 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Data: Certificates, for enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.

1.04 COORDINATION OF BURIED RACEWAYS ON SITE

- A. Coordinate layout and installation of ducts and handholes with final arrangement of other utilities, site grading, and surface features as determined in the field.
- B. Coordinate elevations of ducts and duct-bank entrances into handholes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes.

## 2.01 METAL CONDUITS AND FITTINGS

### A. Metal Conduit:

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. Allied Tube & Conduit; a part of Atkore International.
  - b. Electri-Flex Company.
  - c. O-Z/Gedney; a brand of Emerson Industrial Automation.
  - d. Patriot Aluminum Products, LLC.
  - e. Perma-Cote.
  - f. Picoma Industries, Inc.
  - g. Plasti-Bond.
  - h. Republic Conduit.
  - i. Southwire Company.
  - j. Thomas & Betts Corporation; A Member of the ABB Group.
  - k. Western Tube and Conduit Corporation.
2. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. GRC: Comply with ANSI C80.1 and UL 6.
4. IMC: Comply with ANSI C80.6 and UL 1242.
5. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
  - a. Comply with NEMA RN 1.
  - b. Coating Thickness: 0.040 inch, minimum.
6. EMT: Comply with ANSI C80.3 and UL 797.
7. FMC: Comply with UL 1; zinc-coated steel.
8. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

### B. Metal Fittings: Comply with NEMA FB 1 and UL 514B.

1. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Fittings, General: Listed and labeled for type of conduit, location, and use.
3. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
4. Fittings for EMT:
  - a. Material: Steel.
  - b. Type: Setscrew.
5. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
6. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

### C. Joint Compound for IMC, GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## 2.02 NONMETALLIC CONDUITS AND FITTINGS

- A. Nonmetallic Conduit:
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. Arnco Corporation.
    - b. CANTEX INC.
    - c. CertainTeed Corporation.
    - d. Champion Fiberglass, Inc.
    - e. Condux International, Inc.
    - f. Electri-Flex Company.
    - g. FRE Composites.
    - h. Kraloy.
    - i. Lamson & Sessions.
    - j. Niedax Inc.
    - k. RACO; Hubbell.
    - l. Thomas & Betts Corporation; A Member of the ABB Group.
- B. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
1. RNC: Type EPC-40-PVC or Type EPC-80-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
  2. LFNC: Comply with UL 1660.
  3. Rigid HDPE: Comply with UL 651A.
  4. Continuous HDPE: Comply with UL 651B.
- C. Nonmetallic Fittings:
1. Fittings, General: Listed and labeled for type of conduit, location, and use.
  2. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
  3. Fittings for LFNC: Comply with UL 514B.
  4. Solvents and Adhesives: As recommended by conduit manufacturer.

## 2.03 STANDARD CONDUIT SEALS

- 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 Polywater Corporation
  2. Dura-Line, Inc.
  3. FS3, Inc.
- B. Description: Sealing compound for use in underground conduit to prevent water and gas infiltration in non-classified locations.
1. Semi-permanent, re-enterable seal.
  2. Compatible with PVC, rigid steel, EMT, IMC, fiberglass and polyethylene conduits.
  3. Keeps water, acids, greases, gases, insects, rodents, etc., out of the conduit.
  4. Two-part high-expansion urethane foam with 98% closed cell content.



5. Cured compressive strength of 300 lbs. (ASTM D790), tensile strength of 250 lbs. (ASTM D1623), and flexural strength of 450 lbs. (ASTM D790) and temperature range of -20° to 200°F.
6. Cured sealant will be capable of holding 10 psi water pressure continuously.
7. Meets NEC requirements for raceway seals per Articles 225.27, 230.8 and 300.5
8. FST™ Sealant or equivalent.

#### 2.04 METAL WIREWAYS AND AUXILIARY GUTTERS

- 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. B-line, an Eaton business.
  2. Hoffman; a brand of Pentair Equipment Protection.
  3. MonoSystems, Inc.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1, Type 3R, Type 4 or Type 12 unless otherwise indicated, and sized according to NFPA 70.
  1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Screw-cover type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

#### 2.05 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
  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. Mono-Systems, Inc.
    - b. Panduit Corp.
    - c. Wiremold / Legrand.

#### 2.06 J-HOOKS

- A. Description: Prefabricated sheet metal cable supports for low-voltage cables (lighting controls).
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton, B-line.
  2. Panduit Corp.
  3. Wiremold / Legrand.
- C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

## 2.07 BOXES, ENCLOSURES, AND CABINETS

- 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. Crouse-Hinds, an Eaton business.
  2. Erickson Electrical Equipment Company.
  3. Hoffman; a brand of Pentair Equipment Protection.
  4. Hubbell Incorporated.
  5. Hubbell Incorporated; Wiring Device-Kellems.
  6. Milbank Manufacturing Co.
  7. MonoSystems, Inc.
  8. Oldcastle Enclosure Solutions.
  9. O-Z/Gedney; a brand of Emerson Industrial Automation.
  10. RACO; Hubbell.
  11. Stahlin Non-Metallic Enclosures.
  12. Thomas & Betts Corporation; A Member of the ABB Group.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.
- E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- F. Metal Floor Boxes. See drawings for differing floor box requirements based on location, floor material and box use.
1. All floor boxes shall be:
    - a. Fully adjustable.
    - b. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Specific conditions include:
    - a. Concrete floors (3" min. pour depth) - 4-gang floor box with corrosion resistant coating for on-grade use and up to 2" conduit feed.
    - b. Raised access floors - 4-gang floor box for up to 2" conduit feed.
    - c. Fire rated poke-through floor box for elevated concrete slabs:
      - 1) Small - 3" diameter core.
      - 2) Large - 8" diameter for up to 2" conduit feed.
    - d. Flush, round single surface floor box for concrete floors with up to 1" conduit feed.
    - e. Tombstone pedestal floor box with 1" conduit feed.

3. Include all interior box dividers, flanges, mounting hardware, wiring devices, faceplates, etc. to provide complete floor box outlet in accordance with drawings.
  - G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.
  - H. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb (32 kg).
    1. Listing and labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - I. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
  - J. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
  - K. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
  - L. Device Box Dimensions: 4 inches square by 2-1/8 inches deep with single gang mud ring unless device(s) requires otherwise.
  - M. Gang-able boxes are allowed for 6-gang or larger.
  - N. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1, Type 3R, Type 4 or Type 12 with continuous-hinge cover with flush latch unless otherwise indicated.
    1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
    2. Nonmetallic Enclosures: Plastic.
    3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
  - O. Cabinets:
    1. NEMA 250, Type 1, Type 3R or Type 12 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
    2. Hinged door in front cover with flush latch and concealed hinge.
    3. Key latch to match panelboards.
    4. Metal barriers to separate wiring of different systems and voltage.
    5. Accessory feet where required for freestanding equipment.
    6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- 2.08 DUCT ACCESSORIES FOR BURIED CONDUITS
- A. Duct Separators: Factory-fabricated rigid PVC interlocking, intermediate (horizontal) spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
- 2.09 HANDHOLES FOR EXTERIOR UNDERGROUND WIRING
- A. General Requirements for Handholes:

1. Handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
  2. Handholes shall be listed and labeled for installation in wet areas as defined in NFPA 70. They shall be tested by a qualified testing agency, and marked for intended location and application.
- B. Polymer-Concrete Handholes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
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. Armorcast Products Company.
    - b. NewBasis.
    - c. Oldcastle Enclosure Solutions.
    - d. Oldcastle Precast, Inc.
    - e. Quazite (Hubbell).
  2. Standard: Comply with ANSI/SCTE 77.
  3. Load Ratings:
    - a. Tier 5 for non-traffic areas and sidewalk applications with a safety factor for occasional non-deliberate vehicular traffic.
    - b. Tier 22 for driveway, parking lot, and off-road applications subject to occasional non-deliberate heavy vehicular traffic.
    - c. AASHTO H-20 for roadways and other deliberate vehicular traffic applications.
  4. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
  5. Sides:
    - a. Provide a tapered-side unit when handhole is located in landscaped areas.
    - b. Provide a straight-side unit when handhole is located in hardscape areas.
  6. Cover: Weatherproof, secured by stainless steel, tamper-resistant, locking devices and having structural load rating consistent with enclosure and handhole location.
  7. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  8. Cover Legend: Molded lettering, "ELECTRIC" or "COM" as indicated on drawings.
  9. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

## PART 3 - EXECUTION

### 3.01 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC or Schedule 80 PVC where required by utility or required for special environments. Exposed Schedule 40 PVC is not allowed.
  2. Concealed Aboveground Conduit: EMT.
  3. Underground Conduit: RNC, Type EPC-40-PVC, or HDPE in fine bedded trench.
  4. Elbows for underground conduit:
    - a. Long sweep
    - b. GRS with PVC or bitumastic coating, or fiberglass as required by the utility.

5. Under roadways and paved or concrete walkways: Type EPC-80-PVC or HDPE in fine bedded trench.
  6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  7. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
  8. Provide expansion-joint fittings where required below.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated.
1. Exposed, Not Subject to Physical Damage: EMT.
  2. Exposed, Not Subject to Severe Physical Damage: EMT.
  3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
    - a. Loading dock.
    - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - c. Mechanical rooms.
    - d. Gymnasiums.
    - e. Commercial garages (up to 48" AFF).
  4. Concealed in Ceilings and Interior Walls and Partitions: EMT or as specified in Section 26 05 19, "Low-Voltage Electrical Power Conductors and Cables".
  5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
  6. Damp or Wet Locations: GRC.
  7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 nonmetallic in institutional and commercial kitchens and damp or wet locations.
  8. Concealed in CMU block wall: Type EPC-40-PVC.
- C. Minimum Raceway Size: 1 inch trade size for telecom/data and 3/4 inch trade size for all other applications.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
  3. EMT: Use setscrew, steel fittings. Comply with NEMA FB 2.10.
  4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Install surface raceways only where specifically indicated on Drawings.
- F. Install nonmetallic conduit or tubing for protecting bare grounding conductors.
- G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).
- 3.02 LOW VOLTAGE CABLE INSTALLATION
- A. Any low voltage cables in exposed or finished areas shall be in raceway.

- B. In accordance with NEC 300.11 and NEC 800.24, any low voltage cables installed in accessible ceilings without conduit, including lighting control cables, shall be as follows:
  - 1. Cables shall not be draped over air ducts, pipes, or conduits, shall not rest on the ceiling grid or tiles, and shall not use ceiling grid support wires or rods.
  - 2. Cables shall be supported using j-hooks at intervals not to exceed 48". J-hooks shall be attached to the structure with dedicated support wires, and a j-hook shall be installed at each change in cabling direction.
  - 3. Written approval shall be obtained from the IT designer prior to any use of communications system cable/ladder tray or j-hooks. Wherever cable tray or communication system j-hooks are used, the lighting controls cabling shall be bundled with cable ties. Any non-metallic cable ties used to bundle the cables shall be plenum rated.

### 3.03 INSTALLATION

- A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.
- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
- D. Do not fasten conduits onto the bottom side of a metal deck roof.
- E. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- F. Whenever routed in parallel, maintain 12" minimum separation between communications conduits and power conduits. Where these conduits must intersect, cross at 90 degrees.
- G. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.
- H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- I. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- J. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- K. Support conduit within 12 inches of enclosures to which attached.
- L. Stub-ups to Above Recessed Ceilings:
  - 1. Use EMT for raceways.
  - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

- M. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- N. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- O. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- P. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- Q. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- R. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- S. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- T. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches of slack at each end of pull wire.
- U. Surface Raceways:
  - 1. Install surface raceway with a minimum 2-inch radius control at bend points.
  - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- V. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces.
- W. Standard Conduit Seals:
  - 1. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
    - a. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
    - b. Where an underground service raceway enters a building or structure.
    - c. Conduit extending from interior to exterior of building.
    - d. Conduit extending into pressurized duct and equipment.
    - e. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
    - f. Where otherwise required by NFPA 70.
- X. Expansion-Joint Fittings:

1. Install where RNC (Schedule 80 PVC) is allowed/required for utility riser at service entrance.
  2. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m).
  3. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
    - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
    - d. Attics: 135 deg F (75 deg C) temperature change.
  4. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per degree F of temperature change for PVC conduits.
  5. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  6. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- Y. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
  2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- Z. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- AA. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between the box and cover plate or the supported equipment and box.
- BB. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- CC. Locate boxes so that cover or plate will not span different building finishes.
- DD. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- EE. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- FF. Set metal floor boxes level and flush with finished floor surface.
- GG. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.



3.04 INSTALLATION OF UNDERGROUND CONDUIT

A. General

1. Electrical contractor (EC) shall review all specifications (including Civil) for this project and be responsible for all trenching associated with electrical work, whether the actual work is accomplished by the electrical contractor, the general contractor or other contractors.
2. Prior to any trenching, contact 811 'Call-Before-You-Dig' and coordinate with owner and utilities to locate all buried power, communications, gas, water, sewer, irrigation piping, etc. From this information, establish the best routing and plan for areas that will require hand digging.
3. EC shall be responsible for repair of any damage to existing buried power, communications, gas, water, sewer, irrigation piping, etc. that occurs as a result of trenching for the electrical work. EC shall hire trained and certified craftsmen to perform the repairs and bring them back to 'like existing conditions'. Repair work will not be considered complete until all systems are once again functioning properly and owner is satisfied with the repairs.
4. Any time there are two or more conduits in a trench, intermediate (horizontal) spacers shall be used. These allow for the following:
  - a. Maintaining conduit separation in accordance with NEC 310.15(C)(2).
  - b. Allowing for proper bedding and compaction to a dense and unyielding condition.

B. Excavation

1. Carefully cut and retain sod alive for reinstallation. Saw cut, remove and dispose of concrete and asphalt.
2. Excavate trenches to depth required to install top of duct bank at least 24 inches below finished grade, unless otherwise indicated.
3. Excavate trenches to uniform widths to provide 3 inches on each side of conduits, and sufficiently wide to maintain required separations as noted below.
4. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.
5. Trenches in Tree- and Plant-Protection Zones:
  - a. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
  - b. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.

C. Trench Bedding

1. Excavate and shape trench bottoms to provide uniform bearing and support of conduits. Shape subgrade to provide continuous support for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade. Excavate trenches 6 inches deeper than elevation required to allow for bedding course.
2. Provide 6" of clean, crushed Class I granular bedding material to be installed and compacted in the bottom of the trench prior to installation of conduits. Place backfill on subgrades free of mud, frost, snow, or ice. Shape bedding course to provide continuous support for joints, fittings, and bodies of conduits.

D. Conduit Installation

1. Direct-Buried Duct Banks - Whenever two or more conduits (including spares), or other utilities, are installed in a trench, spacing shall be as follows:
    - a. All conduits/pipes shall be at the same horizontal level within the trench.
    - b. Install molded plastic horizontal spacers every six feet.
    - c. Maintain a minimum 3-inch separation between power conduits.
    - d. Maintain a minimum 12-inch separation between power and communications conduits.
    - e. Maintain a minimum 24-inch separation from water lines.
    - f. Maintain a minimum 24-inch separation from gas or sewer lines.
    - g. All conduit separations are measured surface-to-surface and not center-to-center.
  2. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
  3. Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches between tiers.
  4. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches (100 mm) over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling.
  5. Where spare buried conduits are installed, they shall have pull string as noted above. Cap each end of conduit to avoid entrance of moisture or vermin. Mark dimensioned termination locations on as-built, red-line drawings. Where noted on plans, spare conduits shall terminate in handholes or above grade alongside raceways in use.
  6. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured RGS or fiberglass, long sweep (large radius) bends for both horizontal and vertical bends 45-degree or greater.
  7. Install manufactured duct elbows for stub-up at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
  8. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
    - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
    - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
- E. Backfill - After installing conduit, backfill and compact to 95 percent of adjacent undisturbed soil. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process.
1. Trenches under Footings: Refer to and comply with structural details and specifications.
  2. Trenches under Roadways: Backfill only after concrete is set.

3. Initial Backfill: Place and compact initial backfill of subbase material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the conduits. Carefully compact initial backfill under conduit haunches and compact evenly up on both sides and along the full length of conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
  4. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction.
- F. Underground Warning Tape: Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."
- G. Compaction - Firmly hand tamp backfill around conduit to provide maximum supporting strength. Prior to commencing compaction work, coordinate all requirements with site civil specifications. The most stringent compaction requirements shall take precedence.
1. Compact each layer of initial and final backfill soil material at 95 percent. Refer to geotechnical engineer for relative density of adjacent soils.
- H. Finishing
1. Replace sod to match existing. Pour concrete and replace asphalt to match adjacent surfaces.

### 3.05 INSTALLATION OF UNDERGROUND HANDHOLES

- A. Install handholes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Where required, field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

### 3.06 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### 3.07 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies.

### 3.08 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
  - 1. Color and legend requirements for raceways, conductors, and warning labels and signs.
  - 2. Tapes and stencils.
  - 3. Signs.
  - 4. Cable ties.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Comply with NFPA 70E requirements for arc-flash warning labels.
- F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

2.02 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits within Buildings. Identify the covers of each junction and pull box of the following systems with paint as follows:
  - 1. Battery or Generator Backed up Emergency System: Orange
  - 2. Fire Detection and Alarm System: Red
  - 3. Systems with voltage greater than 600V: Yellow
  - 4. Direct current systems (Solar PV system): Green
  - 5. Affix label with black letters on color noted above indicating voltage and system or service type.
- B. Conductor Color-Coding for Phase and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.

1. Utilize factory applied, colored insulation for No. 8 AWG and smaller.
  2. If Authority Having Jurisdiction permits, for sizes larger than No. 8 AWG, where conductors with factory colored insulation are not commonly available, colored non-aging, plastic tape may be field applied. Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
  3. Colors for Three-Phase Wye, 208/120V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Phase C: Blue.
    - d. Neutral: White.
  4. Colors for Single-Phase, 240/120V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Neutral: White.
  5. Colors for Three-Phase, 480/277V Circuits:
    - a. Phase A: Brown.
    - b. Phase B: Orange.
    - c. Phase C: Yellow.
    - d. Neutral: Gray.
  6. Colors for Three-Phase, Center-Tapped Delta, 240/120V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Wild Leg: Orange.
    - d. Neutral: White.
  7. Color for Equipment Grounds: Bare copper or Green.
  8. Colors for Isolated Grounds: Green with white stripe.
  9. Lighting Circuit Switched Legs and 3-way/4-way Traveler: Color unique to those listed above.
- C. Warning Label Colors:
1. Identify system voltage with black letters on an orange background.
- D. Warning labels and signs shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
  2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."
  3. Arc Flash Warning: "WARNING – KEEP CLEAR. RISK OF ELECTRIC SHOCK OR ARC FLASH. PPE REQUIRED."
- E. Equipment Identification Labels:
1. Black letters on a white field, or white letters on a black field.
  2. Include equipment designation and circuit.
  3. Exterior equipment labels shall have a rivet or screw mounted label on the exterior door.
  4. 1" minimum height letters for service disconnect and emergency shut-off switches.
  5. 1/2" minimum height letters for panelboards, switchboards, relay enclosures and transformers.
  6. 1/4" minimum height letters for disconnect switches and motor starters.

7. 1/8" minimum height letters for device coverplates (where required).

## 2.03 TAPES AND STENCILS

- A. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide; compounded for outdoor use.
- B. Floor Marking Tape: 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.
- C. Underground-Line Warning Tape:
  1. Tape:
    - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
    - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
    - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
  2. Color and Printing:
    - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
    - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
    - c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".
  3. Type:
    - a. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
    - b. Width: 3 inches (75 mm).
    - c. Overall Thickness: 5 mils (0.125 mm).
    - d. Foil Core Thickness: 0.35 mil (0.00889 mm).
    - e. Weight: 28 lb/1000 sq. ft. (13.7 kg/100 sq. m).
    - f. Tensile according to ASTM D 882: 70 lbf (311.3 N) and 4600 psi (31.7 MPa).

## 2.04 SIGNS

- A. Baked-Enamel Signs:
  1. Preprinted aluminum signs, high-intensity reflective, punched or drilled for fasteners, with colors, legend, and size required for application.
  2. 1/4-inch (6.4-mm) grommets in corners for mounting.
  3. Nominal Size: 7 by 10 inches (180 by 250 mm).
- B. Laminated Acrylic or Melamine Plastic Signs:
  1. Engraved legend.
  2. Thickness:
    - a. For signs up to 20 sq. in. (129 sq. cm), minimum 1/16 inch (1.6 mm) thick.
    - b. For signs larger than 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) thick.
    - c. Engraved legend with black letters on white face

- d. Punched or drilled for mechanical fasteners with 1/4-inch (6.4-mm) grommets in corners for mounting.
- e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

## 2.05 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
  - 1. Minimum Width: 3/16 inch (5 mm).
  - 2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 12,000 psi (82.7 MPa).
  - 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
  - 4. Color: Black, except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
  - 1. Minimum Width: 3/16 inch (5 mm).
  - 2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 12,000 psi (82.7 MPa).
  - 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
  - 4. Color: Black.
- C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
  - 1. Minimum Width: 3/16 inch (5 mm).
  - 2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 7000 psi (48.2 MPa).
  - 3. UL 94 Flame Rating: 94V-0.
  - 4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
  - 5. Color: Black.

## 2.06 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

## PART 3 - EXECUTION

### 3.01 COORDINATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.



- B. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

### 3.02 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Apply identification devices to surfaces that require finish after completing finish work.
- C. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- D. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.
- E. Self-Adhesive Identification Products used on the exterior of the building: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product. Labels shall have a rivet or screw mounted on each side of the label, located on the exterior door.
- F. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- G. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.
- H. Underground Line Warning Tape:
  - 1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.
  - 2. Install underground-line warning tape for direct-buried cables and cables in raceways.
- I. Laminated Acrylic or Melamine Plastic Signs:
  - 1. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- J. Cable Ties: General purpose, for attaching tags, except as listed below:
  - 1. Outdoors: UV-stabilized nylon.
  - 2. In Spaces Handling Environmental Air: Plenum rated.

### 3.03 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:
  - 1. "EMERGENCY POWER."
  - 2. "FIRE ALARM."
  - 3. "HIGH VOLTAGE."
  - 4. "DIRECT CURRENT."
- D. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use write-on tags with the conductor or cable designation, origin, and destination.
- E. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive wraparound labels with the conductor designation.
- F. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
  - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
  - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
  - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- H. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- I. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- J. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- K. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive equipment labels.
  - 1. Apply to exterior of door, cover, or other access.
  - 2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
    - a. Power-transfer switches.
    - b. Controls with external control power connections.
- L. Arc Flash Warning Labeling: Self-adhesive labels.
- M. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

- N. Emergency Operating Instruction Signs: Self-adhesive labels, Laminated acrylic or melamine plastic signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer and load shedding.
- O. Equipment Identification Labels:
  - 1. Indoor Equipment: Engraved, laminated acrylic or melamine plastic label.
  - 2. Outdoor Equipment: Engraved, Laminated acrylic or melamine label.
  - 3. Equipment to Be Labeled:
    - a. Panelboards/Switchboards:
      - 1) Label shall be self-adhesive, engraved, laminated acrylic or melamine. Label shall include: Panelboard/switchboard name, voltage, amperage, number of phases and wires, source and available fault current with date calculated.
      - 2) Typewritten directory of circuits in the location provided by panelboard manufacturer. Spares shall be filled in by hand with pencil.
      - 3) On main distribution panel door / switchboard front provide a laminated one-line diagram of the electrical system and all panel configurations.
    - b. Enclosures and electrical cabinets.
    - c. Access doors and panels for concealed electrical items.
    - d. Switchgear.
    - e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    - f. Substations.
    - g. Emergency system boxes and enclosures.
    - h. Motor-control centers.
    - i. Enclosed switches.
    - j. Enclosed circuit breakers.
    - k. Enclosed controllers.
    - l. Variable-speed controllers.
    - m. Push-button stations.
    - n. Power transfer equipment.
    - o. Contactors.
    - p. Remote-controlled switches, dimmer modules, and control devices.
    - q. Battery-inverter units.
    - r. Battery racks.
    - s. Power-generating units.
    - t. Monitoring and control equipment.
    - u. UPS equipment.
    - v. Wiring devices: See specification section "Wiring Devices".

END OF SECTION 26 05 53

## SECTION 26 09 23 - LIGHTING CONTROL DEVICES

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes:
  - 1. Time switches.
  - 2. Outdoor photoelectric switches.
  - 3. Indoor occupancy and vacancy sensors.
  - 4. Switchbox-mounted occupancy sensors
  - 5. Digital timer light switches.
  - 6. High-bay occupancy sensors.
  - 7. Outdoor motion sensors.
  - 8. Lighting contactors.
  - 9. Emergency shunt relays.
  - 10. Lighting Control Relay Panels
- B. Related Requirements:
  - 1. Section 26 27 26 "Wiring Devices" for wall-box dimmers and manual light switches.

#### 1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Show installation details for occupancy/vacancy and light-level sensors.
  - 2. Interconnection diagrams showing field-installed wiring.
  - 3. Include diagrams for power, signal, and control wiring.

#### 1.03 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
- B. Remote Configuration Tools.

#### 1.04 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five year(s) from date of Substantial Completion.
    - a. One (1) on-site visit by factory trained and certified technician, eight months after substantial completion, to recommission and retrain Owner's personnel.

## 2.01 TIME SWITCHES

- A. Manufacturers: Design is based on Intermatic ET1100 Series, but 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. Cooper Industries, Inc.
  - 2. Intermatic, Inc.
  - 3. Leviton Manufacturing Co., Inc.
  - 4. Tork by NSi Industries LLC.
- B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Contact Configuration: SPST, or as noted on plans.
  - 3. Contact Rating: 20A ballast load, 120/240V ac.
  - 4. Programs: Two on-off set points on a 24-hour schedule, allowing different set points for each day of the week and an annual holiday schedule that overrides the weekly operation on holidays.
  - 5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.
  - 6. Astronomic Time: All channels.
  - 7. Automatic daylight savings time changeover.
  - 8. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

## 2.02 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Manufacturers: Design is based on Intermatic NightFox Series, but 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. Cooper Industries, Inc.
  - 2. Intermatic, Inc.
  - 3. Leviton Manufacturing Co., Inc.
  - 4. Tork by NSi Industries LLC.
- B. Description: Solid state, with SPST dry contacts rated for 1000W incandescent or 1800VA tungsten, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A, and compatible with ballasts and LED lamps.
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lux), with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
  - 3. Time Delay: Fifteen-second minimum, to prevent false operation.
  - 4. Surge Protection: Metal-oxide varistor.

5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.
6. Failure Mode: Luminaire stays ON.

## 2.03 INDOOR OCCUPANCY AND VACANCY SENSORS

- A. Manufacturers: Refer to Design Documentation for additional information. Design is based on Acuity n-Light Controls, but subject to compliance with requirements, available manufacturers offering products that may be substituted into the Work include:
1. Cooper Industries, Inc.
  2. Hubbell Building Automation, Inc.
  3. Leviton Manufacturing Co., Inc.
  4. Lithonia Lighting; Acuity Brands Lighting, Inc.
  5. Lutron Electronics Co., Inc.
  6. Philips Lighting Controls.
  7. Sensor Switch, Inc.
- B. General Requirements for Sensors:
1. Wall and Ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
  2. Dual technology (passive infrared and ultrasonic).
  3. Separate power pack, unless installed on gyp. board ceilings or walls.
  4. Hardwired (line or low-voltage) connection to switch.
  5. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  6. Operation (as noted on plans):
    - a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
    - b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  7. Sensor Output: Sensor is powered from the power pack.
  8. Power: Line voltage where installed on gyp. board ceilings or walls.
  9. Power Pack: Dry contacts rated for 20A **LED** load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
  10. Mounting:
    - a. Sensor: Suitable for mounting in any position on a standard outlet box.
    - b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
    - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
  11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
  12. Bypass Switch: Override the "on" function in case of sensor failure.
  13. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lux); turn lights off when selected lighting level is present.

- C. Dual-Technology Type: Wall or Ceiling mounted (as noted on plans); detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
  - 1. Sensitivity Adjustment: Separate for each sensing technology.
  - 2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
  - 3. Ceiling Mounted Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
  - 4. Wall Mounted Detection Coverage: Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 2000 square feet (220 square meters) when mounted 72 inches above finished floor.

#### 2.04 SWITCHBOX-MOUNTED OCCUPANCY SENSORS, DUAL TECHNOLOGY

- A. Manufacturers: Refer to Design Documentation for additional information. Design is based on Acuity n-Light Controls, but subject to compliance with requirements, available manufacturers offering products that may be substituted into the Work include:
  - 1. Cooper Industries, Inc.
  - 2. Hubbell Building Automation, Inc.
  - 3. Leviton Manufacturing Co., Inc.
  - 4. Lithonia Lighting; Acuity Brands Lighting, Inc.
  - 5. Lutron Electronics Co., Inc.
  - 6. Philips Lighting Controls.
  - 7. Sensor Switch, Inc.
- B. Description: Switchbox-mounted, combination lighting-control sensor and conventional switch lighting-control unit using dual technology (passive infrared and ultrasonic).
  - 1. Connections: Hard wired.
  - 2. Rated 1200 W at 120-V ac for tungsten lighting, 10 A at 120-V ac or 10 A at 277-V ac for fluorescent or LED lighting, and 1/6 hp at 120-V ac.
  - 3. Adjustable time delay of 5 to 20 minutes.
  - 4. Comply with NEMA WD 1, UL 20, and FS W-S-896.

#### 2.05 DIGITAL TIMER LIGHT SWITCHES

- A. Manufacturers: Refer to Design Documentation for additional information. Design is based on Acuity n-Light Controls, but subject to compliance with requirements, available manufacturers offering products that may be substituted into the Work include:
  - 1. Cooper Industries, Inc.
  - 2. Intermatic, Inc.
  - 3. Invensys Controls.
  - 4. Leviton Manufacturing Co., Inc.
  - 5. NSi Industries LLC.
  - 6. TE Connectivity Ltd.
  - 7. WattStopper; a Legrand® Group brand.

- B. Description: Combination digital timer and conventional switch lighting control unit. Switchbox-mounted, backlit LCD display, with selectable time interval in 10 minute increments.
  - 1. Rated 960 W at 120-V ac for tungsten lighting, 10 A at 120-V ac or 10 amps at 277-V ac for LED, and 1/4 horsepower at 120-V ac.
  - 2. Voltage: Dual voltage - 120 and 277 V.
  - 3. Color: Match color of other wiring devices.
  - 4. Faceplate: Color matched to switch.

## 2.06 HIGH-BAY OCCUPANCY SENSORS

- A. Manufacturers: Refer to Design Documentation for additional information. Design is based on Acuity n-Light Controls, but subject to compliance with requirements, available manufacturers offering products that may be substituted into the Work include:
  - 1. Cooper Industries, Inc.
  - 2. Hubbell Building Automation, Inc.
  - 3. Leviton Manufacturing Co., Inc.
  - 4. Lithonia Lighting; Acuity Brands Lighting, Inc.
  - 5. Lutron Electronics Co., Inc.
  - 6. Philips Lighting Controls.
  - 7. Sensor Switch, Inc.
- B. Description:
  - 1. Rated for indoor use.
  - 2. Mounting heights between 15' and 40'.
  - 3. Adjustable time delay (15 seconds - 30 minutes; factory preset at 15 minutes).
  - 4. Low-voltage operation with power pack, or line-voltage operation with integral power pack.
  - 5. Operating conditions: Temperature 32-158°F (0-70°C); Humidity 20-90%, non-condensing.
- C. PIR Type: Ceiling mounted; detect occupants in coverage area by their heat and movement.
  - 1. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm).
  - 2. Detection Coverage: Detect occupancy anywhere in a circular area of 40-foot diameter when mounted on a 20-foot high ceiling.
  - 3. Detection Coverage: Detect occupancy anywhere in a circular area of 100-foot diameter when mounted on a 40-foot high ceiling.
  - 4. Detection Coverage: Detect occupancy anywhere in a linear area of 60-foot long when mounted on a 40-foot high ceiling.
- D. Remote Configuration Tool: Include remote configuration tool to allow for sensor setup and adjustment from the floor.

## 2.07 OUTDOOR MOTION SENSORS

- A. Manufacturers: Refer to Design Documentation for additional information. Design is based on Acuity n-Light Controls, but subject to compliance with requirements, available manufacturers offering products that may be substituted into the Work include:
  - 1. WattStopper; a Legrand® Group brand.
  - 2. Cooper Industries, Inc.
  - 3. Hubbell Building Automation, Inc.
  - 4. Leviton Manufacturing Co., Inc.



5. Lithonia Lighting; Acuity Brands Lighting, Inc.
  6. Sensor Switch, Inc.
- B. General Requirements for Sensors: Solid-state outdoor motion sensors.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. PIR type, weatherproof. Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm). Comply with UL 773A.
  3. Switch Rating:
    - a. Luminaire-Mounted Sensor: 1000-W incandescent, 500-VA fluorescent/LED.
    - b. Separately Mounted Sensor: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
  4. Switch Type: SP. with bypass switch to override the "on" function in case of sensor failure.
  5. Voltage: Match the circuit voltage.
  6. Detector Coverage:
    - a. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).
    - b. Long Range: 180-degree field of view and 110-foot (34-m) detection range.
  7. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc (108 to 1600 lux). The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
  8. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
  9. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and help eliminate false "off" switching.
  10. Operating Ambient Conditions: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F (minus 40 to plus 54 deg C), rated as "raintight" according to UL 773A.
- C. Remote Configuration Tool: For any motion sensors mounted on poles or walls at more than 10-feet above grade, include remote configuration tool to allow for sensor setup and adjustment from the ground.

## 2.08 LIGHTING CONTACTORS

- A. Manufacturers: Design is based on ASCO 918 Series, but 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. Allen-Bradley/Rockwell Automation.
  2. ASCO.
  3. Eaton.
  4. General Electric Company.
  5. Square D.

- B. Description: Electrically operated and mechanically held, complying with NEMA ICS 2 and UL 508.
  - 1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less THD of normal load current).
  - 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
  - 3. Enclosure: Comply with NEMA 250.
  - 4. Provide with Hand-Off-Auto switch and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.
  - 5. Provide solid-state control module as required for 2 or 3 wire control.

## 2.09 EMERGENCY LIGHTING CONTROL DEVICES

- A. Manufacturers: Refer to Design Documentation for additional information. Design is based on Acuity n-Light Controls, but subject to compliance with requirements, available manufacturers offering products for compliance:
- B. Emergency Lighting Control Unit - A UL 924 listed device that monitors a switched circuit providing normal lighting to an area. The unit provides normal ON/OFF control of emergency lighting along with the normal lighting. Upon normal power failure the emergency lighting circuit will close, forcing the emergency lighting ON until normal power is restored. Features include:
  - 1. 120/277 volts, 50/60 Hz, 20 amp ballast rating
  - 2. Push to test button
  - 3. Auxiliary contact for remote test or fire alarm system interface

## 2.10 LIGHTING CONTROL RELAY PANEL

- A. Manufacturers: Refer to Design Documentation for additional information. Design is based on Acuity n-Light Controls, but subject to compliance with requirements, available manufacturers offering products that may be substituted into the Work include:
  - 1. Wattstopper.
  - 2. Crestron
  - 3. Hubbell Automation.
  - 4. Leviton.
- B. Panel description:
  - 1. UL Listed with 14,000 SCCR.
  - 2. Enclosure: NEMA 1 rated with hinged, lockable, surface or flush cover (as shown on plans).
  - 3. Interior: Barrier for separation of high voltage (class 1) and low voltage (class 2) wiring.
  - 4. Relays: Up to (8) single-pole or (4) two-pole relays. Relays shall be electrically held relays with auxiliary contacts for pilot light switching. SPST and DPST relays with 20A contact ratings for:
    - a. Light fixture ballasts/drivers.
    - b. General purpose loads.
    - c. 1/2 HP motor at 120V.
    - d. 1 HP motor at 208, 240 or 480V.
  - 5. Back-lit Touchscreen User Interface:

- a. Timeclock with 8 Channels of time control, up to 42 holidays and automatic daylight savings adjustment.
  - b. Non-volatile program memory to retain time keeping during power outages for at least 48 hours.
- C. External Control device interface:
1. 8 universal switch inputs that are low voltage, self-configuring and do not require programming to accept momentary on/ momentary off switch, push button switch (cycling), maintained switch or 24VDC signals from occupancy sensors, photocells or other interfacing devices.
  2. After-hour interior lighting shut off control shall provide a full duration override time of 1 to 240 minutes with a warning blink five minutes prior to shutting the lighting off. An impending shut off will be cancelled and the override period re-initialized by pressing the automatic control switch push button (WattStopper No. AS-100 or equivalent).
  3. Control exterior lighting via photocell input (do not use astronomical clock function).

## 2.11 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multi-conductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables." Consult manufacturer for Class 2 wiring requirements. Provide in a separate raceway if manufacturer does not allow cabling shared with Class 1 cabling.
- C. Class 1 Control Cable: Multi-conductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

## PART 3 - EXECUTION

- 3.01 DEVICE LOCATIONS - Device locations on plan drawings are approximate and are intended to indicate general area to be covered.
1. All devices shall be installed in strict accordance with manufacturer's guidelines.
  2. Contractor shall provide additional devices and associated hardware as required to cover the entire area.
  3. Occupancy sensor locations shall be shifted as necessary to ensure the following:
    - a. Normal devices shall be installed only no higher than 120" AFF.
    - b. No device employing PIR sensing shall be installed in a location where obstacles may block the sensor's field of view.
    - c. Any device employing ultrasonic sensing shall be installed at a minimum of 6' away from any strong transfer of air such as supply diffusers.

3.02 INSTALLATION

- A. Comply with NECA 1.
- B. Examine all lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- C. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- D. Install and aim sensors in locations to achieve not less than 90-percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
- E. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.
- F. Provide detailed point to point wiring diagrams for every termination. Provide wire specifications and wire colors to simplify contactor termination requirements
- G. Install the work of this Section in accordance with manufacturer's printed instructions unless otherwise indicated.
- H. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings.
  - 1. Adjust time delay so that controlled area remains lighted for 5 minutes after occupant leaves area.
- I. Provide written or computer-generated documentation on the commissioning of the system including room by room description including:
  - 1. Sensor parameters, time delays and sensitivities.
  - 2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
  - 3. Load Parameters (e.g. blink warning, etc.)

3.03 WIRING - In general, all devices and equipment shall be wired in accordance with manufacturer's guidelines. Wireless devices shall only be used if specifically approved in writing by the Engineer.

- A. Wiring Method: Comply with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 3/4 inch.
- B. Low voltage cables do not require raceway where concealed in accessible ceilings. Cabling shall be cleanly organized and supported by J-Hooks or approved methods every 6 feet.
- C. Low voltage cables shall be installed in conduit/raceway where exposed.
- D. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- E. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

- F. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

#### 3.04 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 26 05 53 "Identification for Electrical Systems."
  - 1. Identify controlled circuits in lighting contactors.
  - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

#### 3.05 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Lighting control devices will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

#### 3.06 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
  - 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
  - 2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
  - 3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

#### 3.07 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 26 09 23

## SECTION 26 27 26 - WIRING DEVICES

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes:
  - 1. Straight-blade convenience receptacles.
  - 2. TV outlets (power & signal).
  - 3. GFCI receptacles.
  - 4. Toggle switches.
  - 5. Wall-box dimmers.
  - 6. Wall plates.
  - 7. Finishes.

#### 1.02 RELATED DOCUMENTS

- A. Refer to Section 26 09 23 "Lighting Control Devices" for occupancy/vacancy sensors, daylight sensors, low-voltage lighting control panels and devices, room controllers, etc.

#### 1.03 DEFINITIONS

- A. Abbreviations of Manufacturers' Names:
  - 1. Cooper: Copper Wiring Devices; Division of Cooper Industries, Inc.
  - 2. Hubbell: Hubbell Incorporated: Wiring Devices-Kellems.
  - 3. Leviton: Leviton Mfg. Company, Inc.
  - 4. P&S: Pass & Seymour/Legrand.

#### 1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Dimmer switch and LED lamp manufacturers' literature showing compatibility between the two.

#### 1.05 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

### PART 2 - PRODUCTS

#### 2.01 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- B. Comply with NFPA 70.
- C. Devices for Owner-Furnished Equipment:
  - 1. Receptacles: Match plug configurations including wire count, poles, twistlock, etc.
- D. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

## 2.02 STRAIGHT-BLADE RECEPTACLES

- A. Duplex Convenience Receptacles, 125V, 20A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
  - 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. Cooper; 5351 (single), 5362 (duplex), 5362CH (half-controlled duplex).
    - b. Hubbell; HBL5361 (single), HBL5362 (duplex), BR20C1 (half-controlled duplex).
    - c. Leviton; 5361 (single), 5362 (duplex), 5362-S1 (half-controlled duplex).
    - d. P&S; 5351 (single), CRB5362 (duplex), 5362CH (half-controlled duplex).
- B. Tamper-Resistant Convenience Receptacles, 125V, 20A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R UL 498, and FS W-C-596.
  - 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. Cooper; TR5362 (duplex), TR5362CH (half-controlled duplex).
    - b. Hubbell; HBL5362TR (duplex), HBL5362C1TR (half-controlled duplex).
    - c. Leviton; 5362-SG (duplex), 5362-1P (half-controlled duplex)
    - d. P&S; TR5362 (duplex), TR5362CH (half-controlled duplex)

## 2.03 TV OUTLET (POWER & SIGNAL)

- A. Recessed, 2-gang, in-wall enclosure with:
  - 1. Power kit (20A duplex receptacle).
  - 2. 1" conduit and pullstring provision for single cable. Route to accessible ceiling space, and to floor box where applicable.
  - 3. Flush while-in-use cover.
- B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. 2-gang: Hubbell; NSAV62M (recessed box), NSOKPTR (power kit), NSAV6C (cover).

## 2.04 USB CHARGER DEVICES

- A. Tamper-Resistant, USB Charger Receptacles: 12V, 2.0A, USB Type A; Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, UL 1310, and FS W-C-596.
  - 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. Cooper; TR7756.
    - b. Hubbell; USB20A5.

- c. Leviton; T5832.
- d. P&S; TR5362USB.
- 2. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
- 3. USB Receptacles: Dual, Type A.
- 4. Line Voltage Receptacles: Dual, two pole, three wire, and self-grounding.

## 2.05 GFCI RECEPTACLES

- A. General Description:
  - 1. 125V, 20A, straight blade, non-feed-through type.
  - 2. Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 943 Class A, and FS W-C-596.
  - 3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
  - 4. Self-testing:
    - a. Automatic test initiates within 5 seconds of power availability to the line or load terminals and repeats at least every 3 hours.
    - b. If auto-monitoring detects a problem, GFCI will trip with the inability to reset.
- B. Duplex GFCI Convenience Receptacles, 125V, 20A:
  - 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. Cooper; VGF20.
    - b. Hubbell; GFR5352L.
    - c. Leviton; GFNT2.
    - d. P&S; 2097.
- C. Tamper-Resistant, Duplex GFCI Convenience Receptacles, 125V, 20A:
  - 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. Cooper; TRVGF20.
    - b. Hubbell; GFRTRST20.
    - c. Leviton; GFTR2-KW.
    - d. P&S; 2097TR.
- D. Weather Resistant, Self-Testing, Duplex GFCI Receptacles, 125V, 20A:
  - 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. Cooper; WRSGF20.
    - b. Hubbell; GFTWRST20.
    - c. Leviton; GFWR2.
    - d. P&S; 2097TRWR.
  - 2. For use only with wet or damp location covers.

## 2.06 TOGGLE SWITCHES

- A. Comply with NEMA WD 1, UL 20, and FS W-S-896.



B. Switches, 120/277V, 20A:

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. Single Pole:
    - 1) Cooper; AH1221.
    - 2) Hubbell; HBL1221.
    - 3) Leviton; 1221-2.
    - 4) P&S; CSB20AC1.
  - b. Two Pole:
    - 1) Cooper; AH1222.
    - 2) Hubbell; HBL1222.
    - 3) Leviton; 1222-2.
    - 4) P&S; CSB20AC2.
  - c. Three Way:
    - 1) Cooper; AH1223.
    - 2) Hubbell; HBL1223.
    - 3) Leviton; 1223-2.
    - 4) P&S; CSB20AC3.
  - d. Four Way:
    - 1) Cooper; AH1224.
    - 2) Hubbell; HBL1224.
    - 3) Leviton; 1224-2.
    - 4) P&S; CSB20AC4.

C. Lit-Handle Switches, 20A:

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. Cooper; AH1221LT.
  - b. Hubbell; HBL1201IL.
  - c. Leviton; 1221-LH1.
  - d. P&S; PS20AC1-CSL.
2. Description: Single pole, with lighted handle, illuminated when switch is "off".

D. Pilot-Light Switches, 20A:

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. Cooper; AH1221PL (single-pole), AH1222PL (two-pole).
  - b. Hubbell; HBL1221PL (single-pole), HBL1222PL (two-pole).
  - c. Leviton; 1221-PLR (single-pole), 1222-PLR (two-pole).
  - d. P&S; PS20AC1-RPL (single-pole), PS20AC2-RPL (two-pole).
2. Description: Single pole or two-pole, with lighted handle, illuminated when switch is "on."

E. Key-Operated Switches, 120/277V, 20A:

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. Single Pole:
    - 1) Cooper; AH1221L.
    - 2) Hubbell; HBL1221L.
    - 3) Leviton; 1121-2L.
    - 4) P&S; PS20AC1L.
  - b. Two Pole:
    - 1) Cooper; AH1222L.

- 2) Hubbell; HBL1222L.
      - 3) Leviton; 1122-2L.
      - 4) P&S; PS20AC2L.
    - c. Three Way:
      - 1) Cooper; AH1223L.
      - 2) Hubbell; HBL1223L.
      - 3) Leviton; 1123-2L.
      - 4) P&S; PS20AC3L.
    - d. Four Way:
      - 1) Cooper; AH1224L.
      - 2) Hubbell; HBL1224L.
      - 3) Leviton; 1124-2L.
      - 4) P&S; PS20AC4L.
  - 2. Description: Single pole, with factory-supplied key in lieu of switch handle.
- F. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277V, 15A; for use with mechanically held lighting contactors.
- a. Cooper; 1995, 1995L (keyed).
  - b. Hubbell; HBL1557, HBL1557L (keyed)
  - c. Leviton; 1257-W, 1257-L (keyed).
  - d. Pass & Seymour; 1251, 1251L (keyed).

## 2.07 DIGITAL TIMER LIGHT SWITCH

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
- 1. Watt Stopper; TS-200.
  - 2. Hubbell; TD300.
  - 3. P&S; RT-100
- B. Description: Switchbox-mounted, combination digital timer and conventional switch lighting-control unit, with backlit digital display, with selectable time interval from 5 minutes to 12 hours.
- 1. Rated 0-800W at 120V ac, and 0-1200W at 277V ac for tungsten, fluorescent, and LED loads.
  - 2. Optional beep warning every five seconds during last minute of countdown.
  - 3. Optional one second light flash warning at one minute before timer runs out.
  - 4. Time scrolling options for overriding the preset time.
  - 5. Electroluminescent back-lit Liquid Crystal Display shows timer countdown.
  - 6. Integral relay for connection to BAS.

## 2.08 WALL-BOX DIMMERS

- A. General: These are stand-alone dimmer switches. See Section 26 09 23 "Lighting Control Devices" for dimmers that interface with daylight sensors, low-voltage lighting control panels, room controllers, etc.
- B. 0-10V Dimming for LED fixtures:
- 1. Products: Refer to design documents for additional information.
  - 2. Slide dimmer with separate ON/OFF switch button. Lighting is switched ON or OFF at the level currently set by the slider.
  - 3. Designed for use with standard three-way and four-way switches for applications requiring control from multiple locations.

4. Match dimmer to lamp(s) being dimmed in accordance with manufacturer's guidelines.
- C. Dimmer Switches for screw-in LED lamps (LED lamps with integral drivers, designed to replace incandescent or screw-in compact fluorescent lamps):
  1. Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
  2. Match dimmer to lamp(s) being dimmed in accordance with manufacturer's guidelines.
  3. 600 W dimmers shall require no derating when ganged with other devices.

## 2.09 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
  1. Plate-Securing Screws: Metal with head color to match plate finish.
  2. Material for Finished Spaces: Smooth, high-impact thermoplastic [**0.035-inch- (1-mm-) thick, satin-finished.**]
  3. Material for Unfinished Spaces: Galvanized steel.
  4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- B. Damp/Wet Location Covers
  1. General:
    - a. All wiring devices installed in damp or wet locations shall have cast metal covers.
    - b. Covers shall be UL listed and labeled for use in wet and damp locations.
    - c. Distinction between damp and wet locations shall be in accordance with NEC 406.9.
    - d. Cover shall be appropriate for the device orientation with the hinge on top.
    - e. Gasketing shall be provided to seal the cover to the box. Caulking shall be provided as required to seal any gaps between the cover and wall finish material.
  2. Damp Location Covers:
    - a. Cast metal with spring-loaded lift cover to seal the device when it is NOT in use.
    - b. Leviton Series 6196 or equivalent.
  3. Wet Location (Weatherproof-in-Use) Covers:
    - a. Heavy Duty, Lockable, cast metal cover to seal the device whether it is in use or not.
    - b. Intermatic Series WP1010MXD or equivalent.

## 2.10 FINISHES

- A. Device Color:
  1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
  2. Wiring Devices Connected to Emergency Power System: Red.
- B. Wall Plate Color: For thermoplastic covers, match device color, unless noted otherwise.

3.01 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

3.02 Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
  2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
  3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
  4. Install wiring devices after all wall preparation, including painting, is complete.
  5. Coordinate receptacle configuration, location and mounting height with equipment/function it serves.
- B. Conductors:
1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
  2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
  3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
  4. Existing Conductors:
    - a. Cut back and pigtail, or replace all damaged conductors.
    - b. Straighten conductors that remain and remove corrosion and foreign matter.
    - c. Pigtail existing conductors is permitted, provided the outlet box is large enough.
- C. Device Installation:
1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
  2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
  3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
  4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
  5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
  6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
  7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
  8. Tighten unused terminal screws on the device.
  9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

10. Damp Location Covers: Not permitted UNO. **Install only where specified in interior locations.**
  11. Wet Location Covers: Install everywhere outside UNO.
- 3.03 Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.
- 3.04 Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- 3.05 Dimmers:
1. Install dimmers within terms of their listing.
  2. Verify that dimmers used for fan-speed control are listed for that application.
  3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.
  4. Match dimmer to lamp(s) being dimmed in accordance with manufacturer's guidelines.
- B. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.
- C. GFCI Receptacles: Install non-feed-through-type GFCI receptacles.
- 3.06 FIELD QUALITY CONTROL
- A. Test Instruments: Use instruments that comply with UL 1436.
- B. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- C. Perform the following tests and inspections:
1. Tests for Convenience Receptacles:
    - a. Line Voltage: Acceptable range is 105 to 132V.
    - b. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
    - c. Ground Impedance: Values of up to 2 ohms are acceptable.
    - d. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
    - e. Using the test plug, verify that the device and its outlet box are securely mounted.
    - f. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- D. Wiring device will be considered defective if it does not pass tests and inspections.

3.07 IDENTIFICATION

- A. Receptacles: Identify panelboard and circuit number from which the device is served.
  - 1. Mark inside of box or coverplate with permanent marker. Test to ensure that marker lines are not visible on outside of cover when it is installed.
  - 2. Mark outside of coverplate using labeler such as Brother PT-90 to produce 1/8" black letters (white letters if cover is dark) on clear tape.

3.08 WEATHER STRIPPING

- A. Behind exterior wall devices
  - 1. Install a precut foam insulation pad over the fixture and reinstall the cover.

END OF SECTION 26 27 26

SECTION 26 51 00 - LED LIGHTING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
  - 1. Interior lighting fixtures that are designed for and exclusively use LED lamp technology.
  - 2. Emergency power units.
  - 3. Exit signs.
  - 4. Emergency lighting units.
  - 5. Luminaire supports.
- B. Related Sections:
  - 1. Section 26 09 23 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
  - 2. Section 26 27 26 "Wiring Devices".

1.02 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.
- H. THD: Total Harmonic Distortion.

1.03 PRIOR APPROVAL

- A. Prior approvals are not required unless otherwise noted on the Luminaire Schedule.
  - 1. All material supplied to the project must meet or exceed the quality, performance, and have similar features to the product originally specified. It is the contractor's responsibility to ensure that substituted equipment matches the exterior dimensions, weight, and configuration of the specified equipment.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
  2. Ballast/Driver, including THD.
  3. Emergency lighting units including battery and charger.
  4. Energy-efficiency data.
  5. Life, output (lumens, CCT, and CRI), and energy-efficiency data.
  6. Fixture UL/ETL rating.
  7. Design Lights Consortium (DLC) certification and/or Energy Star rating.
  8. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
    - a. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
  9. Color samples (if color is to be chosen by architect/engineer).
  10. Foot-candle calculations for spot lights and flood lights.
  11. List of all parts necessary for particular installation configuration.
- B. Shop Drawings: For nonstandard or custom luminaires.
1. Include plans, elevations, sections, and mounting and attachment details.
  2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  3. Include diagrams for power, signal, and control wiring.

#### 1.05 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.
- B. Sample warranty.

#### 1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data.

#### 1.07 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. Plastic Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
  2. Fixture-mounted, emergency battery pack: One for every 50 emergency lighting unit.
  3. Ballasts/Drivers: One for every 100 of each type and rating installed. Furnish at least one of each type.
  4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.



1.08 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NFPA 70.

1.09 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.
- B. Fire rated assemblies: Fixtures installed in fire rated assemblies shall maintain the fire rating of said assembly. Contractor is required to coordinate with Architectural draws to verify assembly ratings.
- C. Insulated ceiling space: Fixtures installed in an insulated ceiling be IC rated or manufacturer recommended clearances between fixture and insulation. Contractor is required to coordinate with Architectural draws to verify insulated areas above ceilings.

1.10 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five years from date of Substantial Completion.
- C. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions as noted in 260548.16, "Seismic Controls for Electrical Systems".
- B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
  - 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."
  - 2. Component Importance Factor: 1.5.

2.02 GENERAL LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Standards - Where noted on plans, comply with the following:
  - 1. ENERGY STAR or Design Lights Consortium (DLC) certified.
  - 2. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
  - 3. UL Listing: Listed for damp and/or wet locations as required.
  - 4. Recessed luminaires shall comply with NEMA LE 4.
- C. Indoor fixtures shall have a minimum CRI of 80 UNO and a CCT of 4100 K UNO.
- D. Outdoor fixtures shall have a minimum CRI of 65 UNO and a CCT of 4100 K UNO.
- E. Outdoor fixtures shall have mounting type and distribution as noted on plans.
- F. Minimum rated LED lamp life of 50,000 hours to L70.
- G. Lamps dimmable from 100 percent to 10 percent of maximum light output.
- H. Internal ballast/driver, UNO.
- I. Nominal Operating Voltage: As noted on the plans.
- J. Lens Thickness: At least 0.125 inch minimum UNO.
- K. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
  - 1. White Surfaces: 85 percent.
  - 2. Specular Surfaces: 83 percent.
  - 3. Diffusing Specular Surfaces: 75 percent.
- L. Lens and Refractor Gaskets for Exterior Luminaires: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- M. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.
- N. Housings:
  - 1. Rigidly formed, light-tight enclosure that will not warp, sag, or deform in use.
  - 2. Provide weather-tight enclosure with filter/breather for enclosed exterior luminaires.
- O. Metal Parts:
  - 1. Free of burrs and sharp corners and edges.
  - 2. Indoor applications: Sheet metal components shall be steel unless otherwise indicated.
  - 3. Exterior applications: Sheet metal components shall be corrosion-resistant aluminum.
  - 4. Form and support to prevent warping and sagging.
- P. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.

- Q. Diffusers, and Globes - Tempered glass, acrylic or polycarbonate as noted on plans.
  - 1. Acrylic: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
    - a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.
    - b. UV stabilized.
  - 2. Glass: Annealed crystal glass unless otherwise indicated.

## 2.03 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.
- B. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.
- C. Factory-Applied, powder-coat finish, UNO, with standard color chosen by Architect or as noted on plans.
  - 1. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
    - a. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
    - b. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.
  - 2. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
    - a. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
    - b. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

## 2.04 LED ASSEMBLIES

- A. Products UL rated for 40 degree C (104 degrees F) ambient environments.
- B. Minimum 4000K color temperature unless noted otherwise in the drawings.
- C. 50,000 hour fixture life including driver, 5 year warranty.
- D. All products compliant with EISNA LM-79 and LM-80 standards.

2.05 EMERGENCY POWER UNIT

- A. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast. Comply with UL 924.
1. Emergency Connection: Operate all or a portion of LED lamps continuously at an output of 1100 lumens. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
  2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
  3. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    - a. Ambient Temperature: Less than 0 deg F (minus 18 deg C) or exceeding 104 deg F (40 deg C), with an average value exceeding 95 deg F (35 deg C) over a 24-hour period.
    - b. Ambient Storage Temperature: Not less than minus 4 deg F (minus 20 deg C) and not exceeding 140 deg F (60 deg C).
    - c. Humidity: More than 95 percent (condensing).
    - d. Altitude: Exceeding 3300 feet (1000 m).
  4. Nightlight Connection: Operate lamp in a remote fixture continuously.
  5. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
    - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
  6. Battery: Sealed, maintenance-free, nickel-cadmium type.
  7. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
  8. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.
- B. External Type: Self-contained, modular, battery-inverter unit, suitable for powering LED lamps, remote mounted from lighting fixture. Comply with UL 924.
1. Emergency Connection: Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
  2. Retain "Nightlight Connection" Subparagraph below if nightlight connections are used. If used, differentiate two connection modes on Drawings or in the Interior Lighting Fixture Schedule on Drawings.
  3. Nightlight Connection: Operate lamp in a remote fixture continuously.
  4. Battery: Sealed, maintenance-free, nickel-cadmium type.
  5. Charger: Fully automatic, solid-state, constant-current type.
  6. Housing: NEMA 250, Type 1 enclosure. Listed for installation remote from luminaire. Remote assembly shall be located no more than half the distance recommended by the emergency power unit manufacturer
  7. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.

8. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

## 2.06 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
  1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
  2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
    - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
    - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
    - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
    - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
    - f. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

## 2.07 EMERGENCY LIGHTING UNITS

- A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.
  1. Battery: Sealed, maintenance-free, lead-acid type.
  2. Charger: Fully automatic, solid-state type with sealed transfer relay.
  3. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
  4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
  5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
  6. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.08 LUMINAIRE SUPPORTS

- A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gauge (2.68 mm).
- E. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
- F. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

2.09 SCREW-IN BASE FIXTURES

- A. Fixture shall be compatible with common type Medium Base E26 bulb.
- B. Fixture shall be dimming compatible and compatible with dimmable LED type bulb.
- C. Lamp shall be compatible with dimmer switch to allow full, flicker-free dimming throughout the lamp's full dimming range.
- D. Comply with UL1598 and comply with minimum performance requirements for retrofit lamps - NEMA SSL 4.
- E. SPARE LAMPS - Spare lamps shall be provided in quantities of 10% of total lamps of each screw-in base type installed. Quantity of spares shall not be less than four (4) spare lamps for any one lamp type.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- D. Fasten luminaire to structural support.
- E. Supports:
  - 1. Sized and rated for luminaire weight, and weight of emergency power unit where applicable.
  - 2. Able to maintain luminaire position after cleaning, while relamping and when testing emergency power unit.

3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
  4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of fixture weight.
  5. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- F. Flush-Mounted Luminaire Support: Secured to outlet box.
- G. Wall-Mounted Luminaire Support:
1. Attached to structural members in walls or to a minimum 20 gauge backing plate attached to wall structural members.
  2. Do not attach luminaires directly to gypsum board.
- H. Ceiling-Mounted Luminaire Support:
1. Secure to any required outlet box and attach to structural member in ceiling or to a minimum 20 gauge backing plate attached to ceiling structural members.
  2. Do not attach luminaires directly to gypsum board.
  3. Provide offset from ceiling as required by luminaire manufacturer.
  4. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.
- I. Suspended Luminaire Support:
1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
  2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
  3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
  4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- J. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.
1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches (150 mm) from lighting fixture corners.
  2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
  3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.
  4. Install at least two independent support rods or wires from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- K. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.
- L. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly and reinstall.

- M. Remote Mounting of Ballasts/Drivers: Distance between the driver and fixture shall not exceed that recommended by luminaire manufacturer.

### 3.02 IDENTIFICATION

- A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

### 3.03 INSULATED CEILING SPACES

- A. Provide IC rated fixture assemblies or manufacturer recommended clearances between fixture and insulation.

### 3.04 FIRE RATED ASSEMBLIES

- A. Provide fire rated fixture assemblies or a third party fire rated cover.
  - 1. Fire rated covers
    - a. Provide manufacturer recommended clearances for all non IC rated fixtures.

### 3.05 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
  - 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 26 51 00





**SUBSTITUTION REQUEST: DATE SUBMITTED** 2/10/26

- 1.01 SUBMIT TO: SAJ Architects, Jeff Reynoldson, Project Manager at [jeffr@saj-arch.com](mailto:jeffr@saj-arch.com) and Steve Earle, Senior Project Manager, at [steve.earle@hmkco.org](mailto:steve.earle@hmkco.org).

**1.02 PROJECT:** Obsidian Middle School Modernization Project

**1.03 SPECIFIED ITEM:**

- A. SECTION NAME AND NUMBER: Plastic Toilet Compartments 102113.19
- B. PRODUCT TYPE AND NAME AND MODEL: Scranton, Hiny Hiders
- C. PARAGRAPH AND PRODUCT DESCRIPTION: 2.02 Solid Plastic Partitions

**1.04 PROPOSED SUBSTITUTION:**

- A. MANUFACTURER AND MODEL NUMBER(S): ASI Group; ASI Global Partitions & ASI Accurate Partitions
- B. PRODUCT DESCRIPTION: Solid Plastic Partitions
- C. Attached data includes product description, specifications, drawings, photographs, performance, test data and **point by point comparative matrix** adequate for evaluation of request including identification of applicable data portions. Attached data also includes description of changes to Contract Documents the proposed substitution requires for proper installation.
- D. It is the responsibility of the requestee to assemble a comparative matrix outlining key elements of proposed substitution.

**1.05 UNDERSIGNED CERTIFIES FOLLOWING ITEMS, UNLESS MODIFIED BY ATTACHMENTS, ARE CORRECT:**

- A. Proposed substitution does not affect dimensions shown on the drawings.
- B. Undersigned pays for changes to building design, including engineering design, detailing, and construction costs caused by proposed substitution.
- C. Proposed substitution has no adverse effect on other trades, construction schedule, or specified warranty requirements.
- D. Maintenance and service parts are available locally or readily obtainable for proposed substitution.




- 1.06 UNDERSIGNED FURTHER CERTIFIES FUNCTION, APPEARANCE, AND QUALITY OF PROPOSED SUBSTITUTION ARE EQUIVALENT OR SUPERIOR TO SPECIFIED ITEM.
- 1.07 UNDERSIGNED FURTHER CERTIFIES THAT THE MANUFACTURER OF THE PROPOSED SUBSTITUTION IS AWARE OF THIS SUBSTITUTION REQUEST AND AGREES TO THE STATEMENTS NOTED ABOVE.
- 1.08 UNDERSIGNED AGREES THAT THE TERMS AND CONDITIONS FOR SUBSTITUTIONS FOUND IN BIDDING DOCUMENTS APPLY TO THIS PROPOSED SUBSTITUTION.
- 1.09 SUBMITTED BY:
- A. PRINT NAME: Christina Erickson  
SIGNATURE: Christina Erickson
- B. FIRM NAME: United Sales NW
- C. FULL MAILING ADDRESS: 1605 Columbia St Suite 100  
City: Vancouver State: WA Zip: 98660
- D. PHONE: 360-524-6040 E-MAIL: christina@unitedsalesnw.com
- 1.10 FOR USE BY ARCHITECT OR ENGINEER
- A. APPROVED OR APPROVED AS NOTED BY: Emily Edmunds, SAJ Architecture
- B. NOT APPROVED BY: \_\_\_\_\_
- C. RECEIVED TOO LATE: \_\_\_\_\_
- D. REMARKS: \_\_\_\_\_
- E. DATE OF RESPONSE: 2/12/2026

END OF SECTION

## Substitution Request – Side by Side Comparison

	BASE	PROPOSED
PRODUCT NAME	<b>HDPE Toilet Partitions</b>	
PART #	<b>Scranton Hiny Hiders</b>	<b>ASI Solid Plastic Partitions (HDPE) (Global/Accurate)</b>
MATERIAL	Doors, panels and pilasters, constructed from high density polyethylene (HDPE) resins. Partitions to be fabricated from polymer resins compounded under high pressure, forming a single component which is waterproof, nonabsorbent and has a self-lubricating surface that resists marks from pens, pencils, markers and other writing instruments. Cover all plastic components with a protective plastic masking.	Doors, Panels, Screens, and Pilasters: Single sheet solid, homogenous HDPE plastic material formed from waterproof, non-absorbent, high-density polyethylene resins; mark-resistant self-lubricating surface; edges finished smooth.  **All HDPE Partitions are NFPA 286 compliant at no additional cost.
FUNCTIONALITY	<p>Doors - 1 inch (25 mm) thick with all edges rounded to a radius.</p> <p>Panels - 1 inch (25 mm) thick with all edges rounded to a radius.</p> <p>Pilasters - 1 inch (25 mm) thick with all edges rounded to a radius.</p> <p>Headrail - Heavy-duty extruded 6463-T5 alloy aluminum with anti-grip design. Finish to be clear anodized. Fastened to headrail brackets with stainless steel tamper resistant Torx head sex bolt, and fastened at the top of the pilaster with stainless steel tamper resistant Torx head screws.</p> <p>Pilaster Fastening - Easy Install Shoe for Floor Anchored-Overhead Braced and Floor to Ceiling application. Ceiling Hung requires threaded rod being attached to mounting bar.</p> <p>Hardware and Hinges -</p> <ol style="list-style-type: none"> <li>1. Aluminum 8" wrap around hinge</li> <li>2. Continuous Aluminum Hinge: <ol style="list-style-type: none"> <li>a. Length: 54 inches (1372 mm).</li> <li>b. Length: 65 inches (1651 mm).</li> <li>c. Length: 71 inches (1803 mm).</li> </ol> </li> <li>2. Continuous Stainless Steel Helix Hinge: <ol style="list-style-type: none"> <li>a. Length: 54 inches (1372 mm).</li> <li>b. Length: 71 inches (1803 mm).</li> </ol> </li> <li>3. Continuous Stainless Steel Spring Loaded Hinge: <ol style="list-style-type: none"> <li>a. Hinges: 54 inches (1372 mm).</li> </ol> </li> </ol> <p>Continuous brackets-</p> <ol style="list-style-type: none"> <li>1. Aluminum Brackets: Heavy-duty aluminum 6463-T5 alloy.</li> <li>2. PVC Brackets: Extruded PVC plastic.</li> <li>3. Stainless Steel Brackets: Stainless steel type 304.</li> <li>4. Brackets are fastened to pilasters with stainless steel tamper resistant Torx head screws and fastened to the panels with stainless steel tamper resistant Torx head sex bolts.</li> </ol> <p>Latch Mechanism - Aluminum Slide Bolt Latch and Housing: Heavy-duty extruded 6463-T5 alloy aluminum. Latch and housing to have a bright dip anodized finish. Slide bolt and button to have a black anodized finish.</p> <p>Stainless Steel Slide Bolt Latch and Housing: Heavy-duty stainless steel type 304. The latch and housing to have a bright finish. The slide bolt and button to have a black anodized finish.</p>	<p>Doors - Solid, homogenous HDPE; 1 inch (25 mm) thick.</p> <p>Panels - Solid, homogenous HDPE; 1 inch (25 mm) thick.</p> <p>Pilasters - Solid, homogenous HDPE; 1 inch (25 mm) thick.</p> <p>Headrail - Shall be made of heavy-duty anodized extruded Aluminum (6063-T5 Alloy). Headrail is anti-grip and attaches to the top of the pilaster with stainless steel vandal resistant screws. Headrail brackets shall be made from a die cast aluminum alloy and shall be attached to the adjacent wall construction with 2 1/2" stainless steel vandal resistant screws and plastic anchors.</p> <p>Pilaster Fastening - Easy Stall shoe system. 1/4 by 2 inch (6 by 51 mm) steel screws attach Easy Stall shoe to floor. Pilaster to be inserted into shoe and secured after height adjusted. Leveling adjustment to be concealed by pilaster shoe. Height/leveling adjustment to be made via machine thread bolts inserted into factory installed threaded insert in bottom of pilaster.</p> <p>Hardware and Fittings - 8 inch (203 mm) aluminum wrap-around hinge.</p> <p>Hinges - Hinges shall be 8 inches (203 mm) and fabricated from heavy-duty extruded aluminum (6463-T5 alloy) with a brushed anodized finish with wrap-around flanges, surface mounted and through bolted to doors and pilasters. Hinges operate and are field set with adjustable nylon cams. Cams can be set in 30 degree increments.</p> <p>Brackets:</p> <p>Standard heavy duty aluminum stirrup brackets. Heavy duty continuous aluminum brackets Heavy duty type 304 stainless steel continuous brackets</p> <p>Latch - Anodized extruded aluminum, with housing, slide bolt and button.</p> <p>Strike and Keeper - 6 inch (152 mm) wrap-around flanges fabricated from heavy-duty extruded aluminum (6463-T5 alloy) with a brushed anodized finish.</p> <p>Coat Hook and Bumper - Non-ferrous, chrome-plated, with black rubber tip for doorstop.</p> <p>Fastening Hardware- Manufacturer's standard, Type 304 stainless steel, No. 4 satin finish, theft-resistant barrel nuts and machine screws.</p>

**Substitution Request – Side by Side Comparison**

	<p>Strike and Keeper - Heavy-duty extruded aluminum 6436-T5 alloy with a bright dip anodized finish. Secured to pilasters with stainless steel tamper resistant Torx head sex bolts. Bumper shall be made of extruded black vinyl.</p> <p>Coat Hook and Bumper - one coat hook/bumper and door pull made of chrome plated Zamak.</p> <p>Fastening Hardware - 3/4 inch (19 mm) stainless steel tamper resistant Torx head screws.</p> <p>Door Pulls - made of chrome plated Zamak. Equip outswing handicapped doors with second door pull and door stop.</p>	<p>Door Pulls - Non-ferrous, chrome-plated. Standard on ADA compartments. Two per ADA door.</p>
URL		<a href="https://asi-globalpartitions.com/products/solid-plastic-hdpe/">https://asi-globalpartitions.com/products/solid-plastic-hdpe/</a>
TDS URL		<a href="https://asi-globalpartitions.com/reference-library/technical-documents/">https://asi-globalpartitions.com/reference-library/technical-documents/</a>
IMAGE		

Global Partitions and Accurate Partitions are both owned by the same parent company. The ASI Group is a family of companies that manufacture products for various industries but in particular the construction industry and specifically commercial washroom components. Accurate Partitions and Global Partitions are both members of the ASI Group.

Global Partition products are all made in Eastanollee, Georgia. Accurate Partition steel partitions are made in Chicago but their plastic partitions are made in Georgia at one of our three plants in town. There are no differences in hardware offerings as standard between the two partition companies and the panels, pilasters and doors are identical on plastic partition components. The door hinges and latches for steel partitions are also identical. There are some color differences on powder coated steel partitions but the most commonly used colors are exactly the same.

There are no structural or aesthetic differences between Global and Accurate partitions.

Kyle Larson  
Sales and Marketing  
Global Partitions

## Independent Laboratory Testing

### Flame Spread Index and Smoke Developed Index

This document provides results from an independent fire test laboratory on ASI Global Partitions' toilet partitions materials.

Tests were performed in accordance with the American Society for Testing Material ASTM E 84-01 "Test for Surface Burning Characteristics of Building Materials".

ASTM E 84 test results are used by the ICC and NFPA to evaluate burning characteristics of materials classified as Interior Wall and Ceiling Finishes in building materials.

<b><i>Material Type</i></b>	<b><i>Flame Spread</i></b>	<b><i>Smoke Development</i></b>	<b><i>Fire Rating</i></b>
Powder Coated Steel	5	30	Class A
Stainless Steel	0	25	Class A
Plastic Laminate	130	180	Class C
Phenolic	45	110	Class B
Phenolic (Color Thru)	25	65	Class A
Solid Polymer	50	450	Class B
<b><i>ASTM E-84 / UL 723 Guide Lines</i></b>			
Class A Fire Rating ( Class I ) - Flame Spread ( 0 - 25 ) Smoke Developed <= 450 Class B Fire Rating ( Class II ) - Flame Spread ( 26 - 75 ) Smoke Developed <=450 Class C Fire Rating ( Class III ) - Flame Spread ( 76 - 200 ) Smoke Developed <= 450			



The LEED (Leadership in Energy and Environmental Design) Green Building Rating System® is a voluntary standard for developing environmentally responsible, low emission, high-performance, sustainable buildings. It was developed by the U.S. Green Building Council, under contract with the US Department of Energy.

Individual materials and products used in buildings are not certified. The Version 4.1 certification process is for the entire construction project. The project earns “points” towards becoming certified. The categories where points can accumulate for ASI Global Partitions products are as follows:

Sourcing of Raw Materials: LEED V4.1 awards points for buildings that contain recycled, salvaged, reused, or refurbished materials, with points awarded as a function of amount of different manufacturers and sourcing and extraction criteria by cost (3 manufacturers and 20% cost = 1 point, 5 manufacturers and 40% cost = 2 points). Credit is based on the sum of post-consumer recycled material + ½ of post-industrial recycled material. This contributes to Recycled Content credit from “Materials and Resources”.

- For credit achievement calculation, products sourced (extracted, manufactured, purchased) within 100 miles (160 km) of the project site are valued at twice their base contributing cost (or number of products), up to a maximum of 200% of cost, or 2 products.

**ASI Global Partitions products qualify for LEED Certification points as follows:**

LEED Category	Points	Description	Powder Coated Steel	Stainless Steel	Solid Polymer (HDPE)	Phenolic (black core)	Phenolic (Color - Thru)	Plastic Laminate
Sourcing of Raw Materials	1 – 2	Post-Consumer	64%	43.5%	0%	0%	0%	1.1%
		Post Industrial/Pre-Consumer	7%	10%	33%	12%	12%	78.8%
Materials and Resources		Final Assembly Point	Eastanollee, GA 30538					

Date Issued: October 17, 2019

ASI Global Partitions warrants that its products will be free of defects in material or workmanship under normal usage from the date of invoice for a period as stated below.

- **POWDER COATED STEEL**  
Three (3) years against chipping, flaking, cracking or discoloration.
- **STAINLESS STEEL**  
Five (5) years against corrosion or discoloration.
- **MOISTURE GUARD™ PLASTIC LAMINATE**  
Five (5) years against discoloration or delamination.
- **LEGACY PLASTIC LAMINATE**  
Two (2) years against discoloration or delamination.
- **BLACK CORE/COLOR-THRU PHENOLIC**  
Twenty-five (25) years against delamination, breakage or corrosion.
- **SOLID PLASTIC (HDPE)**  
Twenty-five (25) years against delamination, breakage or corrosion.

If material is found to be defective during the above period, the material shall be repaired or replaced (at ASI Global Partitions' discretion) free of charge. No credits or allowances shall be issued for any labor or expenses relating to the repair replacement of components covered under the warranty plan. The repair or replacement of material shall be the sole remedy of purchaser and ASI Global Partitions shall not be liable for incidental, consequential or indirect damages caused by any defects in the partitions or any delay in repairing or replacing defective product.

These warranties shall not be applicable if vandalism, improper installation, or improper cleaning/maintenance of partitions has contributed as just cause for the partition failure. These warranties extend to commercial and industrial purchasers and do not extend to any other persons, including consumers of the partitions. These warranties are in lieu of all other warranties, express or implied, including any implied warranty of merchantability or fitness for a particular purpose or otherwise.





REDMOND SCHOOL DISTRICT  
MODERNIZATION PROJECT  
OBSIDIAN MIDDLE SCHOOL  
SUBSTITUTION REQUEST FORM  
SECTION 01 6023

SUBSTITUTION REQUEST: DATE SUBMITTED 2-12-26

- 1.01 SUBMIT TO: SAJ Architects, Jeff Reynoldson, Project Manager at [jeffr@saj-arch.com](mailto:jeffr@saj-arch.com) and Steve Earle, Senior Project Manager, at [steve.earle@hmkco.org](mailto:steve.earle@hmkco.org).
- 1.02 PROJECT: Obsidian Middle School Modernization Project
- 1.03 SPECIFIED ITEM:
- A. SECTION NAME AND NUMBER: PLASTIC TOILET COMPARTMENTS 10211319
- B. PRODUCT TYPE AND NAME AND MODEL: SOLID PLASTIC (HDPE) - SCRANTON-ARIA
- C. PARAGRAPH AND PRODUCT DESCRIPTION: SOLID PLASTIC TOILET COMPARTMENTS (HDPE) - DOORS, PANELS, PILASTERS, 1" THICK, STAINLESS STEEL HARDWARE
- 1.04 PROPOSED SUBSTITUTION:
- A. MANUFACTURER AND MODEL NUMBER(S): ACCUTECH MFG. SOLID (HDPE)
- B. PRODUCT DESCRIPTION: SOLID (HDPE) FLOOR MOUNT OVERHEAD BRACED WITH STAINLESS STEEL HARDWARE
- C. Attached data includes product description, specifications, drawings, photographs, performance, test data and point by point comparative matrix adequate for evaluation of request including identification of applicable data portions. Attached data also includes description of changes to Contract Documents the proposed substitution requires for proper installation.
- D. It is the responsibility of the requestee to assemble a comparative matrix outlining key elements of proposed substitution.
- 1.05 UNDERSIGNED CERTIFIES FOLLOWING ITEMS, UNLESS MODIFIED BY ATTACHMENTS, ARE CORRECT:
- A. Proposed substitution does not affect dimensions shown on the drawings.
- B. Undersigned pays for changes to building design, including engineering design, detailing, and construction costs caused by proposed substitution.
- C. Proposed substitution has no adverse effect on other trades, construction schedule, or specified warranty requirements.
- D. Maintenance and service parts are available locally or readily obtainable for proposed substitution.



REDMOND SCHOOL DISTRICT  
MODERNIZATION PROJECT  
OBSIDIAN MIDDLE SCHOOL  
SUBSTITUTION REQUEST FORM  
SECTION 01 6023

- 1.06 UNDERSIGNED FURTHER CERTIFIES FUNCTION, APPEARANCE, AND QUALITY OF PROPOSED SUBSTITUTION ARE EQUIVALENT OR SUPERIOR TO SPECIFIED ITEM.
- 1.07 UNDERSIGNED FURTHER CERTIFIES THAT THE MANUFACTURER OF THE PROPOSED SUBSTITUTION IS AWARE OF THIS SUBSTITUTION REQUEST AND AGREES TO THE STATEMENTS NOTED ABOVE.
- 1.08 UNDERSIGNED AGREES THAT THE TERMS AND CONDITIONS FOR SUBSTITUTIONS FOUND IN BIDDING DOCUMENTS APPLY TO THIS PROPOSED SUBSTITUTION.

1.09 SUBMITTED BY:

- A. PRINT NAME: Sebastian Martinez  
SIGNATURE: [Signature]
- B. FIRM NAME: Aculec MFG
- C. FULL MAILING ADDRESS: 1027 South Lincoln Ave.  
City: Santa Ana State: CA Zip: 92705
- D. PHONE: 714-549-2015 E-MAIL: info@aculecmfg.com

1.10 FOR USE BY ARCHITECT OR ENGINEER

- A. APPROVED OR APPROVED AS NOTED BY: Emily Edmunds, SAJ Architecture
- B. NOT APPROVED BY: \_\_\_\_\_
- C. RECEIVED TOO LATE: \_\_\_\_\_
- D. REMARKS: \_\_\_\_\_
- E. DATE OF RESPONSE: 2/12/2026

END OF SECTION

# SOLID PLASTIC TOILET SPECIFICATIONS

## FLOOR-MOUNTED OVERHEAD-BRACED

### PART 1 – GENERAL

#### 1.1. SUMMARY

##### A. Selection Includes:

1. Solid plastic [toilet compartments] [urinal screens] [privacy screens].

#### 1.2. REFERENCES

##### A. Advancing Standards Transforming Markets (ASTM International)

1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

##### B. National Fire Protection Association (NFPA):

1. NFPA 286 – Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.

#### 1.3. SYSTEM DESCRIPTION

##### A. Compartment Configurations:

1. Floor mounted overhead braced toilet partitions, privacy screens, and entry partitions.
2. Urinal screens: wall or floor mounted.

#### 1.4 SUBMITTALS

##### A. Submittals for Review:

1. Shop Drawings: Dimensioned layout and elevations.
2. Product Data: Manufacturer's descriptive data for panels and hardware.
3. Samples: 2"x3" samples available upon request.

##### B. Sustainable Design Submittals:

1. Recycled Content: Certify post-consumer and pre-consumer recycled content.
2. Regional Materials: Certify distances from manufacturing and raw material sources.

#### 1.5 QUALITY ASSURANCE:

- ##### A. Manufacturer Qualifications: Over 15 years experience of outstanding manufacturing experience in solid plastic toilet compartments.

#### 1.6 WARRANTIES:

- ##### A. Provide manufacturer's 25-year warranty against breakage, corrosion, and delamination under normal conditions.
- ##### B. Warranty void if material is exposed to direct sunlight (causing warping), stored leaning against a wall, or stored outside recommended room temperature. Material must be stored flat, indoors, at room temperature.

# SOLID PLASTIC TOILET SPECIFICATIONS

## FLOOR-MOUNTED OVERHEAD-BRACED

### PART 2 – PRODUCTS

#### 2.1 MANUFACTURERS

A. Accu Tec Manufacturing, Inc.

B. Substitutions: Requests for substitutions shall be considered only if the proposed product meets or exceeds the established design intent, performance criteria, material requirements, and dimensions outlined in this specification.

1. Manufacturers seeking to have a product approved as "equal" must submit complete product data, technical specifications, fire performance data (NFPA 286 or ASTM E84, as applicable), maintenance information, and samples at least 10 days prior to bid date unless otherwise permitted by the architect.

2. Substitutions will be accepted only when the architect determines that the proposed product:

I. Maintains equal or superior material quality, durability, and fire/safety compliance.

II. Fully matches the design intent, configuration, appearance, and functionality described in the contract documents.

III. Does not require architectural or structural redesign.

IV. Does not affect other trades or installed work.

3. Submittals submitted without supporting documentation may be rejected without review.

#### 2.2. MATERIALS

##### A. MATERIALS

1. Solid HDPE polymer resins, single thickness, 1" thick, edges rounded to ¼" radius.

2. Waterproof, nonabsorbent, graffiti-resistant.

3. Fire hazard classification: Not required OR Class A/B per ASTM E84 OR pass NFPA 286.

4. Recycled content: Minimum 25% (if applicable).

5. Color: To be selected from manufacturer's full color range.

B. Aluminum Extrusions: ASTM B221, 6463-T5 alloy, clear anodized finish.

C. Stainless Steel: ASTM A167, Type 304, satin finish.

#### 2.3 HARDWARE

*(All aluminum hardware shall have a clear anodized finish; all stainless steel hardware shall have a satin finish.)*

##### A. HINGES:

1. 8" heavy-duty extruded aluminum, wrap-around flanges, field-adjustable nylon cams.

# SOLID PLASTIC TOILET SPECIFICATIONS

## FLOOR-MOUNTED OVERHEAD-BRACED

### 2.4 COMPONENTS

- A. Doors/Panels: 55" high, mounted 14" above finished floor.
- B. Pilasters: 82" high, anchored with HDPE or stainless steel shoes.
- C. Pilaster Shoes:
  - 1. HDPE, injection molded, sizes from 3"-12" (1" increments), 14"-24" (even sizes only).
  - 2. Stainless steel, Type 304, 20-gauge, same size range.
- D. Headrail:
  - 1. 1" heavy-duty extruded aluminum, anti-grip profile, clear anodized finish.
- E. Headrail Brackets: 20-gauge stainless steel, satin finish.

### PART 3 – EXECUTION

#### 3.1 INSTALLATION

- A. Install compartments in accordance with manufacturer's instructions and approved shop drawings.
- B. Install plumb, level, and rigid.
- C. Bottom edges of doors and panels to be 14" above finished floor.
- D. Provide maximum  $\frac{3}{8}$ " vertical clearance at doors.
- E. No evidence of cutting, drilling, or patching is acceptable.

#### 3.2 ADJUSTING

- A. Adjust doors and latches for proper operation.

SOLID PLASTIC

# ACCU TEC LIMITED WARRANTY

Accu Tec Manufacturing warrants its toilet partitions, dressing compartments, shower stalls, vanities, and benches to be free from defects in material and workmanship that (1) Occur as a direct result of the manufacturing process, (2) Occur under normal use and service, (3) Occur during the applicable warranty period, (4) Result in breakage or delamination.

## Warranty Periods

•Toilet Partitions (HDPE & Aluminum):	25 years
•Shower Stalls / Dressing Compartments / Vanities:	25 years
•Benches:	25 years

## This limited warranty is subject to the following conditions:

1. Products must be installed according to manufacturer's written instructions and drawings.
2. Warranty applies only to the original installation. Any alterations or reinstallations void the warranty unless approved in writing by Accu Tec Manufacturing.
3. This warranty is void if defects arise from:
  - A. Structural issues unrelated to our product (e.g., settling, shifting, or movement of the building or substructure).
  - B. Vandalism, neglect, misuse, or improper handling during or after installation.
  - C. Improper or insufficient ventilation.
  - D. Exposure to direct sunlight, which can cause warping.
  - E. Improper storage, including leaning against a wall or storing in extreme temperatures. Products must be stored flat and indoors at room temperature prior to installation.

## Remedy

If a warranted product is found defective within the warranty period, Accu Tec Manufacturing will, at its sole discretion, either:

- Repair the defective product,
- Replace the defective product, or
- Refund the original purchase price.

The remedy does not include labor, removal, or reinstallation costs. Replacement parts will be matched as closely as possible to the original but may not be exact.

## Disclaimer

This warranty is the sole and exclusive warranty provided by Accu Tec Manufacturing. It replaces all other expressed or implied warranties, including implied warranties of merchantability or fitness for a particular purpose. Accu Tec Manufacturing shall not be liable for any special, incidental, or consequential damages.

This warranty gives you specific legal rights. You may also have other rights which vary by state or province.

For warranty inquiries, contact:  
Accu Tec Manufacturing  
1027 S. Linwood Ave. Santa Ana, CA. 92705  
Phone number: (714) 549-2015  
Fax number: (714) 549-2087  
Email: [info@accutecmfg.com](mailto:info@accutecmfg.com)

ACCUTECMFG.COM

ACCU-TEC

# SOLID PLASTIC

## CARE AND MAINTENANCE

### Handling & Storage

- Lay material flat. Do not store against a wall or stack unevenly; improper storage can cause warping.
- Leave protective masking on panels and doors until installation is complete to prevent scratches.
- Use care when lifting parts; do not slide or drag across surfaces.
- When moving with a forklift, protect edges — forks can easily damage the material.
- If banding is used, apply protective corners to prevent indentations.
- Extreme heat warning: surface temperatures beyond normal indoor exposure may cause melting, sagging, warping, discoloration, or increased expansion/contraction.
- Protect from direct sunlight. Product is not intended for outdoor use; sunlight exposure voids warranty.
- Store products horizontally, flat, and indoors at room temperature until installation.
- Keep surfaces free from construction debris such as dust, sand, concrete, or tile residue.
- Do not use any HDPE material as a work surface.

### Cleaning:

#### Dirt & Graffiti

- Clean with water and mild detergent.
- Avoid abrasive cleaners, pads, or brushes that may scratch the surface.
- Do not use cleaners containing acetic acid/vinegar.
- Always test new cleaners on a scrap piece or inconspicuous area before full use.

#### For stubborn stains, use:

- $\frac{1}{2}$  cup household detergent +  $\frac{2}{3}$  cup trisodium phosphate + 1 gallon water, OR
- Non-abrasive industrial strength cleaners.
- For adhesive residue from masking, use mineral spirits or acetone (avoid hardware contact).

#### Cuts & Scratches

- Minor cuts and scratches can often be burnished by rubbing with a smooth, rounded object (such as a spoon handle).

To restore appearance, spray surfaces lightly with silicone polish for a bright, glossy finish.

#### Maintenance Note:

Accu Tec solid plastic partitions are low-maintenance and will not rust or delaminate. Like a new painted surface or automobile, regular cleaning ensures the best long-term appearance.



Company: \_\_\_\_\_ Contact: \_\_\_\_\_

Address: \_\_\_\_\_

Email: \_\_\_\_\_

Phone: \_\_\_\_\_ Cell: \_\_\_\_\_ ☐ Bidding as Prime Contractor

Company: \_\_\_\_\_ Contact: \_\_\_\_\_

Address: \_\_\_\_\_

Email: \_\_\_\_\_

Phone: \_\_\_\_\_ Cell: \_\_\_\_\_ ☐ Bidding as Prime Contractor

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