PROJECT MANUAL

ENT & General Surgery Clinics

Alta View Clinic

9450 South 1300 East
Sandy, Utah 84094

Intermountain Health

Construction Documents

August 1, 2025

NJRA Project Number:
25207.00

NJRA ARCHITECTS
5223 S. Ascension Way, Suite 350 | Murray, Utah 84123 | Phone: (801) 364-9259
www.njraarchitects.com

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A/E CERTIFICATE OF SUBSTANTIAL COMPLETION

Project Name:	**Project Name** **Address** **City, State, Zip**	**Intermountain Health:**	**IHC Health Services, Inc.** **36 South State Street, 21st Flr** **Salt Lake City, Utah, 84111**
Intermountain Health Project No:	**1001XXXX**		
Contractor:	**Name** **Address** **City, State, Zip**	**A/E:**	**Name** **Address** **City, State, Zip**
Agreement For:	**Construction**	**Certificate Number:**	**Enter No. (e.g., BP001)**
Agreement Date:	**DD/MM/YEAR**	**DATE OF SUBSTANTIAL COMPLETION:**	**DD/MM/YEAR**

THE DEFINITION OF SUBSTANTIAL COMPLETION is the stage in the progress of the Work when the Project Work or designated portion of the Project is sufficiently complete in accordance with the Contract Documents so Intermountain Health can occupy and utilize the Project Work for its intended use. The Project Work, or designated portion of the Project, identified and described below has been reviewed and found, to the A/E's best knowledge, information, and belief, to be substantially complete.

(A/E to identify the Project Work, or designated portion of the Project, that is substantially complete)

A/E to enter Project Work text here.

WARRANTIES

The **DATE OF SUBSTANTIAL COMPLETION** of the Project Work or portion designated above is the date established by this Certificate, which is also the date of commencement of applicable warranties required by the Contract Documents, except as stated below:

(A/E to identify warranties that do not commence on the date of Substantial Completion, if any, and indicate their date of commencement)

A/E to enter N/A, None, or additional text here.

WORK TO BE COMPLETED OR CORRECTED

A list of Project Work items to be completed or corrected has been prepared by the Contractor and provided to the A/E. This list has been reviewed, amended, and additional Project Work items have been documented by the A/E. This list is attached hereto or included by reference. The failure to include any Project Work items does not alter the responsibility of the Contractor to complete all Project Work in accordance with the Contract Documents. This Certificate is subject to provisions of the A/E's Project Manual substitution section and does not include items noted as unacceptable or nonconforming.

(A/E to identify the list of Project Work to be completed or corrected)

A/E to enter text or See attached Punch List as applicable.

The date of commencement of warranties for **WORK TO BE COMPLETED OR CORRECTED** items on the attached list will be the date of the final Intermountain Health approval of the Contractor's final Application and Certification For Payment, unless otherwise agreed to in writing.

The Contractor will complete or correct the Project Work items attached or referenced hereto within the timeframe indicated from the **DATE OF SUBSTANTIAL COMPLETION**: Thirty (30) days. Time is of the essence in completing or correcting the Project Work items identified in the attached list.

In addition to any other holdback or retention, Intermountain Health will withhold $0.00 from the Contract Sum until Contractor has completed and corrected the Project Work items identified in the attached list.

The Contractor will secure from Authorities Having Jurisdiction (AHJ) the Certificate of Occupancy, Fire Clearance approvals, State Department of Health approvals, and any other approvals required prior to full possession by Intermountain Health. These documents, including the **WORK TO BE COMPLETED OR CORRECTED** items, if any, are attached for reference to this Certificate.

Intermountain Health accepts the Project Work, or designated portion of the Project, as substantially complete as determined by the A/E and will assume full possession thereof at: Enter Time and Date (verify all AHJ approvals will be provided).

Neither this certificate nor the achievement of Substantial Completion shall constitute a release or waiver by Intermountain Health of any claims or Contractor obligations (including without limitation claims or obligations relative to warranty, patent or latent defects, indemnity, bonds, insurance, payments).

Nothing herein will be construed to relieve the Contractor of its duty to perform the Work in accordance with the Contract Documents

By signing this document, Intermountain Health, the Contractor, and the A/E agree and accept the foregoing and the responsibilities assigned to Intermountain Health and to the Contractor in this A/E Certificate of Substantial Completion.

Contractor:	**A/E:**	**Intermountain Health:**
Contractor Firm Contractor Rep. Name - Title	A/E Firm A/E Rep. Name - Title	IHC Health Services, Inc. Adam Jensen
Signature Date	Signature Date	Executive Director, Design and Construction Date
		System Construction Director[1] Date
		FD&C Project Manager Date

[1] For local facility managed projects, System Construction Director to sign.

APPLICATION AND CERTIFICATION FOR PAYMENT

To Owner: IHC Health Services, Inc.
36 South State Street
Salt Lake City, UT 84111

Owner Project #: Owner Project #

Application #: 1

Application Date: 12/1/2018

From Contractor: Contractor Name
Address
City, State, Zip

Via A/E: Architect Name
Address
City, State, Zip

Period To: 12/31/2018

Contract Invoice #: 1

Contract Date: 12/17/2016

Project Name: Project Name

CONTRACTOR'S APPLICATION FOR PAYMENT

Application is made for payment, as shown below, in connection with the Contract.
The Continuation Sheet is attached.

1. Original Contract Sum	$	100.00	
2. Total Contract Change By Change Orders	$	-	
3. Current Contract Sum	$	100.00	
4. Total Completed & Stored To Date	$	75.00	75.00%
5. Retention:			
5.1 This Period Retention	$	1.25	
5.2 Previously Withheld Retention	$	2.50	
5.3 Total Retention Withheld	$	3.75	5.00%
5.4 Previously Released Retention	$	-	
5.5 This Period Retention Released	$	-	
5.6 Total Retention Released	$	-	0.00%
5.7 Current Total Retention Withheld	$	3.75	100.00%
6. Total Earned Less Retainage	$	71.25	
7. Less Previous Certificates For Payments	$	-	0.00%
8. Current Payment Due[3]	**$**	**23.75**	23.75%
9. Balance To Finish, Plus Retention	$	76.25	76.25%

Change Order Summary	Amount
Total Changes Approved in Previous Months By Owner	$ -
Total Approved Changes This Month	$ -
Total Contract Change By Change Orders	$ -

CONTRACTOR[3]: Contractor Name

The undersigned Contractor certifies that to the best of the Contractor's knowledge, information and belief the Work covered by this Application for Payment has been completed in accordance with the Contract Documents, that all amounts have been paid by the Contractor for Work for which previous Certificates for Payment were issued and payments received from the Owner, and that current payment shown herein is now due.

By:[3] John Doe Date: 12/31/2018

State of:
Subscribed and sworn to before me this _____ day of _____
Notary Public:
My Commission Expires:

A/E's CERTIFICATE FOR PAYMENT

In accordance with the Contract Documents, based upon on-site observations and the data comprising the application, the A/E certifies to the Owner that to the best of the A/E's knowledge, information and belief the Work has progressed as indicated, the quality of the Work is in accordance with the Contract Documents, and the Contractor is entitled to payment of the Amount Certified.

Amount Certified..... **$23.75**

A/E:
By: _____ Date: _____

This Certificate is not negotiable. The amount certified is payable only to the Contractor named herein. Issuance, payment and acceptance of payment are without prejudice to any rights of the Owner or Contractor under this Contract.

Approved by FD&C PM[1, 2]: _____
(Signature) (Date)

[1] For major capital projects, FD&C Project Manager to sign. For geographical area managed projects, geographical area Project Manager to sign.

[2] Intermountain's "Monthly Pay Application Checklist" must be submitted by PM with Contractor's Application & Certification for Payment before processing.

[3] Contractor has verified the work associated with the "Current Payment Due" and has attached all relevant invoices and backup information with this application & certification for payment.

36 S. State Street / 21st Floor / Salt Lake City, Utah 84111
(801) 442-2000 / FAX (801) 442-3178

CONTINUATION SHEET

Application and Certification for Payment,
Containing Contractor's signed certification is attached.

Project Name: Project Name
Owner Project #: Owner Project #
Application #: 1

Application Date: 12/1/2018
Period To: 12/31/2018
Contractor Invoice #: 1

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Item No.	Description of Work	Original Contract Sum (CM/GC Pre-Construction Fee; Contract Buyouts)	Total Contract Change By Change Orders	Current Contract Sum (C + D)	Work Completed		Materials Presently Stored This Period (Not in F or G)	Total Completed and Stored Through This Period (F + G + H)	% (I / E)	Balance To Finish (E - I)	This Period Retention (G + H * 5%)	Total Retention Withheld (I * 5%)	This Period Retention Released	Total Retention Released	Current Payment Due[3] (G + H - L + N)
					From Previous Applications	This Period In Place									
00001	Enter Description of Work	$ 100.00	$ -	$ 100.00	$ 50.00	$ 25.00	$ -	$ 75.00	75%	$ 25.00	$ 1.25	$ 3.75	$ -	$ -	$ 23.75
00002		$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -
00003		$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -
00004		$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -
00005		$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -
00006		$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -
00007		$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -
00008		$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -
00009		$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -
00010		$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -
00011		$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -
00012		$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -
00013		$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -
00014		$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -
00015		$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -
00016		$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -
00017		$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -
00018		$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -
00019		$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -
00020		$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -
00021		$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -
00022		$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -
00023		$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -
00024		$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -
00025		$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -
00026		$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -
00027		$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -
00028		$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -
00029		$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -	$ -
Intermountain Project Grand Totals		$ 100.00	$ -	$ 100.00	$ 50.00	$ 25.00	$ -	$ 75.00	75%	$ 25.00	$ 1.25	$ 3.75	$ -	$ -	$ 23.75

36 S. State Street / 21st Floor / Salt Lake City, Utah 84111
(801) 442-2000 / FAX (801) 442-3178

Attachment "D"

UTAH

CONDITIONAL WAIVER AND RELEASE UPON PROGRESS PAYMENT

TO:	IHC HEALTH SERVICES, INC.	("Owner")
FROM:	ENTER CONTRACTOR NAME	("Contractor")
PROPERTY NAME:	Enter Project Name	("Property")
PROPERTY LOCATION:	Enter Project Address	
CONTRACT DATE:	Enter Date (April 16, 2019)	
INVOICE DATE/NUMBER:		("Invoice")
PAYMENT PERIOD:		
PAYMENT AMOUNT:	$	("Payment Amount")

Under this Conditional Waiver and Release, Contractor releases Owner and the Property from, and waives, any notice of lien or right under Utah law (see Utah Code Ann., Title 38, Chapter 1a, Pre-construction and Construction Liens, and Utah Code Ann., Title 14, Contractors' Bonds, or Section 63G-6a-1103) related to payment rights the Contractor has on the Property once:

1. Contractor endorses a check in the Payment Amount payable to Contractor or provides valid wire transfer or direct deposit instructions; and
2. The check is paid by the depository institution on which it is drawn or the wired or direct-deposited funds in the Payment Amount are deposited into Contractor's designated account.

This Conditional Waiver and Release applies to the progress payment for the work, materials, equipment, or combination of work, materials, and equipment furnished by Contractor to the Property or to Owner covered by the Invoice. This Conditional Waiver and Release does not apply to any retention withheld; any items, modifications, or changes pending approval; disputed items and claims; or items furnished or invoiced after the Invoice Period.

Contractor warrants that it either has already paid, or will promptly use the Payment Amount received to pay in full all of Contractor's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or combination of work, materials, and equipment under the Invoice. Contractor has not assigned any lien or right to perfect a lien against the Property and has the right, power, and authority to execute this Conditional Waiver and Release.

ENTER CONTRACTOR NAME, a Enter

Corporation Type

By:_____
Print Name:_____
Title:_____

Attachment "D"

UTAH

WAIVER AND RELEASE UPON FINAL PAYMENT

TO:	IHC HEALTH SERVICES, INC.	("Owner")
FROM:	ENTER CONTRACTOR NAME	("Contractor")
PROPERTY NAME:	Enter Project Name	("Property")
PROPERTY LOCATION:	Enter Project Address	
CONTRACT DATE:	Enter Date (April 16, 2019)	
INVOICE DATE/NUMBER:		("Invoice")
PAYMENT PERIOD:		
TOTAL PAYMENT AMOUNT:	$	("Payment Amount")

Under tis Waiver and Release, Contractor releases Owner and the Property from, and waives, any notice of lien or right under Utah law (see Utah Code Ann., Title 38, Chapter 1a, Pre-construction and Construction Liens, and Utah Code Ann., Title 14, Contractors' Bonds, or Section 63G-6a-1103) related to payment rights the Contractor has on the Property once:

1. Contractor endorses a check in the Payment Amount payable to Contractor or provides valid wire transfer or direct deposit instructions; and
2. The check is paid by the depository institution on which it is drawn or the wired or direct-deposited funds in the Payment Amount are deposited into Contractor's designated account.

This Waiver and Release applies to the final payment for the work, materials, equipment, or combination of work, materials, and equipment furnished by Contractor to the Property or to Owner.

Contractor warrants that it either has already paid, or will promptly use the Payment Amount received to pay in full all of Contractor's laborers, subcontractors, materialmen, and suppliers for all work, materials, equipment, or combination of work, materials, and equipment under the Invoice. Contractor has not assigned any lien or right to perfect a lien against the Property and has the right, power, and authority to execute this Waiver and Release.

ENTER CONTRACTOR NAME, a Enter

Corporation Type

By:_____
Print Name:_____
Title:_____

UTILITIES SHUTDOWN REQUEST (Utilities & Emergency Egress, Etc.)

Project Name:	**Project Name** **Address** **Address**	**Contractor:**	**Contractor** **Contact Name** **Phone Number**
Owner:	**IHC Health Services, Inc.**	**Contractor(s)/ Subcontractor(s) Performing Work:**	**Contractor** **Contact Name** **Phone Number**
FD&C PM:	**PM Name**		
Start of Impairment:	**Date** **Time**	**End of Impairment:**	**Date** **Time**

IMPAIRMENT REQUIREMENTS

*The Utilities Shutdown Request **MUST** be approved by Facility Management 3 working days (min.) before work begins.*

*Facility Management **MUST** be notified when work is ready to begin and when work is complete.*

*Facility Management and Contractor(s) will reactivate system(s) at approved times and **MUST** be notified if impairments need to be extended.*

SECTION 1 – IMPAIRED INFORMATION TO BE COMPLETED BY CONTRACTOR

AREA(S) AFFECTED (Building, Floor, Area/Department, Users, Devices, etc.)

Text

TYPE OF SHUTDOWN (CHECK ALL THAT APPLY)

☐ **Electrical**	☐ Emergency Power* ☐ Main Switch Gear* ☐ Individual Panel	☐ Single Breaker ☐ Fire Alarm System* ☐ _____	
☐ **Plumbing**	☐ Sewer Stock ☐ Vent ☐ Hot Water Domestic	☐ Cold Water Domestic ☐ Steam Line ☐ _____	
☐ **Sprinkler**	☐ Riser* ☐ Individual Heat ☐ Horizontal Mains/Areas	☐ Valves* ☐ _____	
☐ **Medical Gas**	☐ Compressed Air ☐ Oxygen ☐ Nitrous Oxide	☐ Vacuum ☐ Special Mix Gas ☐ Zone Valve Boxes	☐ _____

☐ **Mechanical**	☐ Chilled Water ☐ Steam ☐ Glycol	☐ Hot Water ☐ Compressor ☐ Condenser	☐ VAV's ☐ Electrical Disconnects ☐ _____

* Requires Fire Alarm & Security Coordination

FACILITY PERMITS

☐ ****Above Ceiling**

☐ ****Hot Work**

☐ ****Infection Control Risk Control (ICRA)**

☐ ****Other**_____

** Completed forms must be attached

PERCENT OF IMPAIRMENT (For partial impairment, attach a list showing the area, smoke head, fire suppression system etc. that will be impaired)

Text

REASON FOR IMPAIRMENT

Text

COMMENTS

Text

ATTACHMENTS

1. *3_Pre-Construction GC Detailed Shutdown Plan_Template.xlsx*
2. *Facility Site Area Floor Plan*

SECTION 2 – TO BE COMPLETED BY FACILITY MANAGEMENT

1. Will fire alarm be taken off line for any amount of time? Yes _____ No _____
   If Yes, Facility Management must review and sign. _____
2. Will this impairment extend more than 4 hours? Yes _____ No _____
   If Yes, a fire watch must be implemented, Intermountain Healthcare Safety Officer and Insurance Provider must be notified.
3. Department Managers of impaired areas notified:
   Facility Management: _____ Date: _____
   FD&C Project Manager: _____ Date: _____

Above Ceiling Work Permit

**Standards Referenced: NFPA 101 2012; NFPA 30 2012; NFPA 45 2011; NFPA 99 2012

Facility Name: Permit No.:

Requestor Name: Project No.:

Company/Dept: Work/PO No.:

Contact Phone:

Start Date: Start Time:

End Date: End Time:

Exact Location of Work:

Description of Work:

Will ANY penetrations be made in walls, roof, floor or ceilings? ☐ Yes ☐ No

Will wiring or data cabling be installed or modified? ☐ Yes ☐ No

Type of Wiring

- ☐ Communication
- ☐ Door Control
- ☐ Low or High Voltage Electrical
- ☐ Fiber Optic
- ☐ Fire Alarm
- ☐ HVAC
- ☐ Security
- ☐ Telephone
- ☐ Television
- ☐ Other -

Will fixtures, appliances, duct work or equipment be installed? ☐ Yes ☐ No

How will the work be supported?

- ☐ Fastened to deck or structure
- ☐ Fastened to wall
- ☐ Existing cable tray
- ☐ Existing pipe rack or conduit rack
- ☐ New cable tray
- ☐ New pipe rack or conduit rack
- ☐ Other -

Intermountain Point of Contact: POC Phone:

Print Name Clearly

Site Pre-Inspection

Intermountain Representative: Requestor:

Print Name Clearly Print Name Clearly

Notes or Observations (if any):

Site Post-Inspection

Intermountain Representative: Requestor:

Print Name Clearly Print Name Clearly

☐ No unsealed penetrations observed ☐ All installations properly supported

Notes or Observations (if any):

Intermountain Review and Approval of Work

Intermountain Representative: Date:

Signature

Why do we have to do this?

Because more people die of smoke inhalation in fires than die of fires in fires.

Because 6% of all TJC findings at Intermountain are penetrations in smoke or fire barriers.

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Hot Work Permit

Facility Name:

Requestor Name:

Company/Dept:

Contact Phone:

Permit No.:

Project No.: Start Date: End Date:

Work / PO No.: Start Time: End Time:

Exact Location of Work:

Description of Work:

Heat Sources

☐ Gas Torch ☐ Grinder ☐ Arc Welder ☐ Drill ☐ Chemical

☐ Other -

Will work require disabling fire detection or suppression systems? ☐ Yes ☐ No

Will systems be disabled longer than 4 hours in any 24 hours? ☐ Yes ☐ No

Will work generate smoke, odors or fumes? ☐ Yes ☐ No

Establishing The Work Area

☐ 35' space clear of combustibles
☐ Fire blankets or protective mats in place
☐ Space is well-ventilated
☐ Signage and barricades in place
☐ Safety observer on hand
☐ Other precautions:

☐ Appropriate fire extinguishers on hand
☐ Confined space permit on hand or not needed
☐ Atmosphere tested non-explosive
☐ Welding shields are in place as needed
☐ Fire watch arranged for

Intermountain Point of Contact: POC Phone:

Emergency Phone Number:

Upon Conclusion of Work

Name of Fire Watch Personnel: Supervisor:

☐ Fire watch was kept for 60 minutes after hot work was complete

☐ No sign of smoke or fire was detected during fire watch

Notes or Observations (if any):

Intermountain Review and Approval of Work

Intermountain Point of Contact: Date:

Why do we have to do this?

Because more people die of smoke inhalation in fires than die of fires in fires.

Because 6% of all TJC findings at Intermountain are penetrations in smoke or fire barriers.

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Intermountain Health

Infection Control Risk Assessment 2.0
Matrix of Precautions for Construction, Renovation and Operations

ICRA 2.0 Infection Control Risk Assessment and Permit	Project Name:	AVH IR Rad Room 2		
	ICRA Number:		Requested by	Mark Richins
Location of Work Activity	AVH B4L0		Project Start Date	TBD
Company Performing Work	TBD		Est. Completion Date	
Contractor Superintendent	TBD		Phone	
Contractor Project Manager	TBD		Phone	
Intermountain Project Manager	Mark Richins		Phone	385-226-6001
Industrial Hygiene	Kevin Engh		Phone	801-662-1030
Infection Preventionist	Jessica Osguthorpe		Phone	801-554-3185

1. Type of Activity

○ **Type A**: **Inspection and non-invasive activities.**
Includes but is not limited to:
- Removal of ceiling tile for visual inspection-limited to 1 tile per 50 square feet with limited exposure time.
- Limited building system maintenance (e.g., pneumatic tube station, HVAC system, fire suppression system, electrical and carpentry work to include painting without sanding) that does not create dust or debris.
- Clean plumbing activity limited in nature.

○ **Type B: Small-scale, short duration activities that create minimal dust and debris.**
Includes but is not limited to:
- Work conducted above the ceiling (e.g., prolonged inspection or repair of firewalls and barriers, installation of conduit and/or cabling, and access to mechanical and/or electrical chase spaces).
- Fan shutdown/startup.
- Installation of electrical devices or new flooring that produces minimal dust and debris.
- The removal of drywall where minimal dust and debris is created.
- Controlled sanding activities (e.g., wet or dry sanding) that produce minimal dust and debris.

○ **Type C: Large-scale, longer duration activities that create a moderate amount of dust and debris.**
Includes but is not limited to:
- Removal of preexisting floor covering, walls, casework or other building components.
- New drywall placement.
- Renovation work in a single room.
- Non-existing cable pathway or invasive electrical work above ceilings.
- The removal of drywall where a moderate amount of dust and debris is created.
- Dry sanding where a moderate amount of dust and debris is created.
- Work creating significant vibration and/or noise.

◉ **Type D: Major demolition and construction activities.**
Includes but is not limited to:
- Removal or replacement of building system component(s).
- Removal/installation of drywall partitions.
- Invasive large-scale new building construction.
- Renovation work in two or more rooms.

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2. Patient Risk Area			
◉ **Low Risk**	○ **Medium Risk**	○ **High Risk**	○ **Highest Risk**
Non-patient care areas such as:	Patient care support areas such as:	Patient care areas such as:	Procedural, invasive, sterile support and highly compromised patient care areas such as:
• Public hallways and gathering areas not on clinical units. • Office areas not on clinical units. • Breakrooms not on clinical units. • Bathrooms or locker rooms not on clinical units. • Mechanical rooms not on clinical units. • EVS closets not on clinical units.	• Waiting areas. • Clinical engineering. • Materials management. • Sterile processing department - dirty side. • Kitchen, cafeteria, gift shop, coffee shop, and food kiosks. • Outpatient exam rooms (no procedures)	• Outpatient procedure rooms • All acute care units • Emergency department • Employee health • Pharmacy - general work zone • Medication rooms and clean utility rooms • Imaging suites: diagnostic imaging • Laboratory.	• All transplant and intensive care units. • All oncology units. • OR theaters and restricted areas. • Procedural suites. • Pharmacy compounding. • Sterile processing department - clean side. • Transfusion services. • Dedicated isolation wards/units. • Imaging suites: invasive imaging.

3. Class of Precautions				
	Activity Type			
Patient Risk	Type A	TYPE B	TYPE C	TYPE D
Low	○ I	○ II	○ II	◉ III*
Medium	○ I	○ II	○ III*	○ IV
High	○ I	○ III	○ IV	○ V
Highest	○ III	○ IV	○ V	○ V

Infection control permit and approval will be required when Class of Precautions III (Type C) and all Class of Precautions IV or V are necessary.

Environmental conditions that could affect human health, such as sewage, mold, asbestos, gray water and black water will require Class of Precautions IV for LOW and MEDIUM Risk Groups and Class of Precautions V for HIGH and HIGHEST Risk Groups.

***Type C [Medium Risk groups] and Type D [Low Risk Groups] work areas [Class III precautions] that cannot be sealed and completely isolated from occupied patient care spaces should be elevated to include negative air exhaust requirements as listed in Class IV Precautions.**

4. Surrounding Area					
Unit	Below: N/A	Above: Imaging	Lateral: EVS	Behind: N/A	In Front: EVS
Risk group		High	Low		Low
Contact		Tawna Ivey	Bart Sayer		Bart Sayer
Phone		801-501-2492	801-501-2618		801-501-2618
Controls	☐ Noise ☐ Vibration ☐ Dust ☐ Ventilation ☐ Pressurization	☒ Noise ☒ Vibration ☐ Dust ☐ Ventilation ☐ Pressurization	☒ Noise ☒ Vibration ☐ Dust ☐ Ventilation ☐ Pressurization	☐ Noise ☐ Vibration ☐ Dust ☐ Ventilation ☐ Pressurization	☒ Noise ☒ Vibration ☐ Dust ☐ Ventilation ☐ Pressurization
Systems impacted:	☐ Data ☐ Mechanical ☐ Med Gas ☐ Hot/Cold Water ☐ Other	☐ Data ☒ Mechanical ☒ Med Gas ☒ Hot/Cold Water ☐ Other	☐ Data ☒ Mechanical ☒ Med Gas ☒ Hot/Cold Water ☐ Other	☐ Data ☐ Mechanical ☐ Med Gas ☐ Hot/Cold Water ☐ Other	☐ Data ☒ Mechanical ☒ Med Gas ☒ Hot/Cold Water ☐ Other

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Were there discoveries in surrounding areas that would serve as cause to increase the class of precautions and necessitate additional controls? If so, please summarize.

5a. Required Infection Control Precautions by Class | Before and During Work Activity	
Class of Precautions	**Mitigation Activities (Performed Before and During Work Activity)**
Class I	☐ Perform noninvasive work activity as to not block or interrupt patient care. ☐ Perform noninvasive work activities in areas that are not directly occupied with patients. ☐ Perform noninvasive work activity in a manner that does not create dust. ☐ Immediately replace any displaced ceiling tile before leaving the area and/or at end of noninvasive work activity.
Class II	☐ Perform only limited dust work and/or activities designed for basic facilities and engineering work. ☐ Perform limited dust and invasive work following standing precautions procedures approved by the organization. ☐ This Class of Precautions must never be used for construction or renovation activities.
Class III	☒ Provide active means to prevent airborne dust dispersion into the occupied areas. ☒ Means for controlling minimal dust dispersion may include hand-held HEPA vacuum devices, polyethylene plastic containment, or isolation of work area by closing room door. ☒ Remove or isolate return air diffusers to avoid dust from entering the HVAC system. ☒ Remove or isolate the supply air diffusers to avoid positive pressurization of the space, ☒ If work area is contained, then it must be neutrally to negatively pressurized at all times. ☒ Seal all doors with tape that will not leave residue. ☒ Contain all trash and debris in the work area. ☒ Nonporous/smooth and cleanable containers (with a hard lid) must be used to transport trash and debris from the construction areas. These containers must be damp-wiped cleaned and free of visible dust/debris before leaving the contained work area. ☒ Install an adhesive (dust collection) mat at entrance of contained work area based on facility policy. Adhesive mats must be changed routinely and when visibly soiled. ☒ Maintain clean surroundings when area is not contained by damp mopping or HEPA vacuuming surfaces.
Class IV	☒ Construct and complete critical barriers meeting NFPA 241 requirements including: Barriers must extend to the ceiling or, if ceiling tile is removed, to the deck above, and all penetrations through the barrier shall meet the appropriate fire rating requirements. ☒ All (plastic or hard) barrier construction activities must be completed in a manner that prevents dust release. Plastic barriers must be effectively affixed to ground and ceiling and secure from movement or damage. Apply tape that will not leave a residue to seal gaps between barriers, ceiling or floor. ☒ Seal all penetrations in containment barriers, including floors and ceiling, using approved materials (UL schedule firestop if applicable for barrier type). ☐ Containment units or environmental containment units (ECUs) approved for Class IV precautions in small areas totally contained by the unit and that has HEPA-filtered exhaust air. ☐ Remove or isolate return air diffusers to avoid dust entering the HVAC system. ☐ Remove or isolate the supply air diffusers to avoid positive pressurization of the space. ☐ Negative airflow pattern must be maintained from the entry point to the anteroom and into the construction area. The airflow must cascade from outside to inside the construction area. The entire construction area must remain negatively pressurized. ☐ Maintain negative pressurization of the entire workspace by use of HEPA exhaust air systems directed outdoors. Exhaust discharged directly to the outdoors that is 25 feet or greater from entrances, air intakes and windows does not require HEPA-filtered air. ☐ If exhaust is directed indoors, then the system must be HEPA filtered. ☐ Prior to start of work, HEPA filtration must be verified by particulate measurement and must not alter or change airflow/pressure relationships in other areas. ☐ Exhaust into shared or recirculating HVAC systems, or other shared exhaust systems (e.g., bathroom exhaust) is not acceptable.

	☐ Install device on exterior of work containment to continually monitor negative pressurization. To assure proper pressure is continuously maintained, it is recommended that the device(s) have a visual pressure indicator. ☐ Contain all trash and debris in the work area. ☐ Nonporous/smooth and cleanable containers (with a hard lid) must be used to transport trash and debris from the construction areas. These containers must be damp-wiped cleaned and free of visible dust/debris before leaving the contained work area. ☐ Worker clothing must be clean and free of visible dust before leaving the work area. HEPA vacuuming of clothing or use of cover suits is acceptable. ☐ Workers must wear shoe covers prior to entry into the work area. Shoe covers must be changed prior to exiting the anteroom to the occupied space (non-work area). Damaged shoe covers must be immediately changed. ☐ Install an adhesive (dust collection) mat at entrance of contained work area based on facility policy. Adhesive mats must be changed routinely and when visibly soiled. ☐ Consider collection of particulate data during work to monitor and ensure that contaminates do not enter the occupied spaces. Routine collection of particulate samples may be used to verify HEPA filtration efficiencies.

Class V	☐ Construct and complete critical barriers meeting NFPA 241 requirements including: Barriers must extend to the ceiling, or if ceiling tile is removed, to the deck above, and all penetrations through the barrier shall meet the appropriate fire rating requirements. ☐ All (plastic or hard) barrier construction activities must be completed in a manner that prevents dust release. Plastic barriers must be effectively affixed to ground and ceiling and secure from movement or damage. Apply tape that will not leave a residue to seal gaps between barriers, ceiling or floor. ☐ Seal all penetrations in containment barriers, anteroom barriers, including floors and ceiling using approved materials (UL schedule firestop if applicable for barrier type). ☐ Construct anteroom large enough for equipment staging, cart cleaning, workers. The anteroom must be constructed adjacent to entrance of construction work area. ☐ Workers will be required to wear disposable coveralls during demolition activities. Disposable coveralls must be removed before leaving the work area anteroom. ☐ Remove or isolate return air diffusers to avoid dust entering the HVAC system. ☐ Remove or isolate the supply air diffusers to avoid positive pressurization of the space. ☐ Negative airflow pattern must be maintained from the entry point to the anteroom and into the construction area. The airflow must cascade from outside to inside the construction area. The entire construction area must remain negatively pressurized. ☐ Maintain negative pressurization of the entire workspace using HEPA exhaust air systems directed outdoors. Exhaust discharged directly to the outdoors that is 25 feet or greater from entrances, air intakes and windows does not require HEPA-filtered air. ☐ If exhaust is directed indoors, then the system must be HEPA filtered. ☐ Prior to start of work, HEPA filtration must be verified by particulate measurement and must not alter or change airflow/pressure relationships in other areas. ☐ Exhaust into shared or recirculating HVAC systems, or other shared exhaust systems (bathroom exhaust) is not acceptable. ☐ Install device on exterior of work containment to continually monitor negative pressurization. To assure proper pressure is continuously maintained, it is recommended that the device(s) have a visual pressure indicator. ☐ Contain all trash and debris in the work area. ☐ Nonporous/smooth and cleanable containers (with a hard lid) must be used to transport trash and debris from the construction areas. These containers must be damp-wiped cleaned and free of visible dust/debris before leaving the contained work area. ☐ Worker clothing must be clean and free of visible dust before leaving the work area anteroom. ☐ Workers must wear shoe covers prior to entry into the work area. Shoe covers must be changed prior to exiting the anteroom to the occupied space (non-work area). Damaged shoe covers must be immediately changed. ☐ Install an adhesive (dust collection) mat at entrance of contained work area based on facility policy. Adhesive mats must be changed routinely and when visibly soiled. ☐ Consider collection of particulate data during work to monitor and ensure that contaminates do not enter the occupied spaces. Routine collection of particulate samples may be used to verify HEPA filtration efficiencies.

5b. Additional details (Controls, Specifications/Materials, Verification method/frequency

Recommended Noise & Vibration Mitigation Strategies
• Use diamond drills instead of powder-actuated fasteners. • Schedule noise-making periods with adjacent spaces. • Use beam clamps instead of shot. • Prefab where possible. • Use tin snips to cut metal studs instead of using a chop saw. • Install metal decking with vent tabs, then use cellular floor deck hangers. • Consider compression style fittings instead of soldering, brazing or welding. • Wet core drill instead of dry core or percussion. • Instead of jackhammering concrete, use wet diamond saws. • Use HEPA vacuums instead of standard wet/dry vacuums. • Use mechanical joining system sprinkler fittings instead of threaded. • Where fumes are tolerated, use chemical adhesive remover (flooring glue) instead of mechanical. • To remove flooring, consider abrasive blasting instead of using a floor scraper. • Use electric sheers instead of reciprocating saw for ductwork cutting. • Install exterior man/material lifts.
Recommended Ventilation & Pressurization Mitigation Strategies
• HEPA to exterior. • Install temporary ductwork. • Utilize temporary HVAC equipment. • Vacate the area. • Install temporary partitions. • Use carbon filtration to filter odors.
Recommended Impact to Other Systems Mitigation Strategies
• Schedule outages. • Provide temporary systems. • Back-feed electricity or medical gases.

6. Minimum Required Infection Control Precautions | Upon Completion of Work Activity	
Class of Precautions	**Mitigation Activities (Performed upon Completion of Work Activity)**
Classes I, II and III	Cleaning: 1. Clean work areas including all environmental surfaces, high horizontal surfaces and flooring materials. 2. Check all supply and return air registers for dust accumulation on upper surfaces as well as air diffuser surfaces. HVAC Systems: 1. Remove isolation of HVAC system in areas where work is being performed. Verify that HVAC systems are clean and operational. 2. Verify the HVAC systems meet original airflow and air exchange design specifications.
Classes III, IV and V	Class III (Type C Activities only), IV, and V precautions require inspection and documentation for downgraded ICRA precautions. Construction areas must be inspected by an infection preventionist or designee and engineering representative for discontinuation or downgrading of ICRA precautions. Work Area Cleaning: 1. Clean work areas including all environmental surfaces, high horizontal surfaces and flooring materials. 2. Check all supply and return air registers for dust accumulation on upper surfaces as well as air diffuser surfaces. Removal of Critical Barriers: 1. Critical barriers must remain in place during all work involving drywall removal, creation of dust and activities beyond simple touch-up work. The barrier may NOT be removed until a work area cleaning has been performed. 2. All (plastic or hard) barrier removal activities must be completed in a manner that prevents dust release. Use the following precautions when removing hard barriers: i. Carefully remove screws and painter tape. ii. If dust will be generated during screw removal, use hand-held HEPA vacuum. iii. Drywall cutting is prohibited during removal process. iv. Clean all stud tracks with HEPA vacuum before removing outer hard barrier. v. Use a plastic barrier to enclose area if dust could be generated. Negative Air Requirements: 1. The use of negative air must be designed to remove contaminates from the work area. 2. Negative air devices must remain operational at all times and in place for a period after completion of dust creating activities to remove contaminants from the work area and before removal of critical barriers. HVAC systems: 1. Upon removal of critical barriers, remove isolation of HVAC system in areas where work is being performed. 2. Verify that HVAC systems are clean and operational. 3. Verify the HVAC systems meets original airflow and air exchange design specifications.

Permit Approval

Please note that the IP signature below is approval of the work activity as described, assessed, and documented here. **Should the scope of work change or upon the discovery of additional toxic or biological substances, STOP WORK and seek additional approval and guidance before proceeding.**

Infection Preventionist Signature	

Intermountain Health

Negative Pressure Log

Month/Year:		Project:	
Date	Initials	Pressure Reading (min -0.01 inWG)	Comments

*Optional form - use where applicable

Intermountain Health

Rounding Log

Date	Initials	Comments

*Optional form - use where applicable

A/E SUPPLEMENTAL INSTRUCTIONS ASI # 001

Project Name:	**Project Name Address Address**	**A/E:**	**A/E**
Bid Package:	**1.0X**	**Date:**	**Date Issued**
Owner:	**IHC Health Services, Inc.**	**ASI Page Count:**	**XX**
Intermountain Project #:	**Project ID #**	**ASI Prepared By:**	**Name**
FD&C PM:	**PM Name**	**Contractor:**	**Contractor**
ASI Description:	**Description**		

Reason For Change (Required):

☐A/E Error ☐A/E Omission ☐A/E Request ☐GC Request ☐Owner/FD&C Request ☐Functional Request

☐Unknown Condition

The Work shall be executed in accordance with the following supplemental instructions, which interpret the Contract Documents or order minor changes in the Work without change in Construction Costs, Contract Sum and/or Contract Time.

If the Contractor believes that a change in Construction Costs, Contract Sum, and/or Contract Time is warranted, the Contractor shall submit written notice in the form of a Proposed Change Order (PCO) substantiating such claim to the A/E. The claim shall be made in accordance with the provisions of the Contract Documents. The Owner's authorization is required prior to proceeding with any Work which will incur additional cost and/or time.

DETAILED DESCRIPTION:

Text

ATTACHMENTS:

Text

Approved by FD&C[1]: _____
(Signature) (Date)

[1] For major and geographical capital projects, FD&C Project Manager to sign.

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CONSTRUCTION CHANGE DIRECTIVE CCD # 001

Project Name:	**Project Name** **Address** **Address**	**A/E:**	**A/E**
Bid Package:	**1.0X**	**Date:**	**Date Issued**
Owner:	**IHC Health Services, Inc.**	**CCD Page Count:**	**XX**
Intermountain Project #:	**Project ID #**	**CCD Prepared By:**	**Name**
FD&C PM:	**PM Name**	**Contractor:**	**Contractor**
CCD Subject:	**Subject**		

Reason For Change (Required):

☐A/E Error ☐A/E Omission ☐A/E Request ☐GC Request ☐Owner/FD&C Request ☐Functional Request

☐Unknown Condition

ESTIMATED CHANGE IN CONSTRUCTION COSTS, CONTRACT SUM, OR CONTRACT TIME:	**$**

In order to expedite the work and avoid or minimize delays in the work which may affect the contract sum and/or contract time, the Contract Documents are hereby amended as described below. Proceed with this work promptly. Submit final costs for work involved and change in Contract Time (if any as a Proposed Change Order), for inclusion in a subsequent Change Order, per the General Conditions.

All work shall be in accordance with the terms, stipulations and conditions of the original Contract Documents.

DESCRIBE BRIEFLY ANY PROPOSED CHANGES:

Text

ATTACHMENTS:

Text

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Approved by FD&C PM[1]: _____
(Signature) (Date)

Approved by System Construction Director[2]: _____
(Signature) (Date)

Approved by Executive Director[3]: _____
(Signature) (Date)

[1] For major and geographical capital projects, FD&C Project Manager to sign.

[2] System Construction Director to sign when the charge exceeds $40,000 for geographical managed projects, or $200,000 for major capital projects, as outlined in the "*Approval Authority Capital Expenditures Policy*".

[3] Executive Director, Design & Construction to sign when the charge exceeds $200,000 as outlined in the "*Construction Change Order Procedure*".

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CHANGE ORDER

CO # 001

Project Name:	**Project Name** **Address** **Address**	**Contractor:**	**Contractor**
Bid Package:	**1.0x**	**CO Date:**	**Date Issued**
Owner:	**IHC Health Services, Inc.**	**CO Page Count:**	**XX**
Intermountain Project #:	**Project ID**	**CO Prepared By:**	**Name**
FD&C PM:	**PM Name**	**A/E:**	**A/E**

This Change Order is not valid until signed by the Owner, A/E, and Contractor.

CO Description: **Description**

PCO #	Description	Reason for Change	Amount
		Total This Change Order:	**$**

CO Details:

The Original Contract Sum	$
The net change by previously authorized Change Orders	$
The Contract Sum prior to this Change Order	$
The Contract Sum will be increased (decreased) by this Change Order	$
The new Contract Sum including this Change Order, will be	$
The Contract Time will be increased (decreased) by	
The date of Substantial Completion as of this Change Order therefore is	

Contractor:
Contractor Firm
Contractor Rep. Name - Title

A/E:
A/E Firm
A/E Rep. Name - Title

Intermountain Health:
IHC Health Services, Inc.
Clay L. Ashdown / Adam C. Jensen[1]

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Signature	Date	Signature	Date	Sr. Vice President, Finance Operations / Executive Director, Design and Construction	Date
				Executive Director[2]	Date
				System Construction Director[3]	Date
				FD&C Project Manager[4]	Date

[1] Executive Director, Design and Construction to sign when Change Order amount is $100,000 or less, otherwise, Sr. Vice President, Finance Services is required to sign per the "Contract Policy" and "Approval Authority Expenditures Policy".

[2] Executive Director, Design & Construction to sign in this location when Change Order exceeds $100,000.

[3] System Construction Director to sign in this location as pertaining to their portfolio of work.

[4] For major and geographical capital projects, FD&C Project Manager to sign.

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PROPOSED CHANGE ORDER PCO # 001

Project Name:	**Project Name Address Address**	**Contractor:**	**Contractor**
Bid Package:	**1.0X**	**PCO Issue Date:**	**Date Issued**
Owner:	**IHC Health Services, Inc.**	**PCO Page Count:**	**XX**
Intermountain Project #:	**Project ID #**	**PCO Prepared By:**	**Name**
FD&C PM:	**PM Name**	**A/E:**	**A/E**

*Once this document is executed the Contractor is authorized to proceed with the work described below and to include this PCO in a Change Order for A/E and Owner approval.

PCO Description:	**Description**
Reference:	**Reference ASI, RFI, PR, CCD change document this PCO is in response to.**

Reason For Change (Required):

☐*A/E Error ☐*A/E Omission ☐A/E Request ☐GC Request ☐Owner/FD&C Request ☐**Functional Request

☐Unknown Condition

*If A/E Error or A/E Omission is checked, the Contractor is to provide pricing delta (bid cost vs. C.O. cost) to determine A/E responsibility.
**If Functional Request is checked, the Facility (or responsible department) and FD&C PM are to determine the Facility's cost responsibility, including design fees and the Facility representative is to initial the PCO or provide email acknowledgement of financial commitment and attach to PCO. FD&C PM to coordinate with Capital Finance on facility reimbursement once PCO is signed.
***Contract Time request must be in compliance with the Agreement, General Conditions, and be included in a subsequent Change Order.

PCO Details:

***A/E is responsible for $_____. Agreed to if PCO is signed.**
****Facility is responsible for $_____. Agreed to if PCO is signed.**

Item	Subcontractor	Description	Amount
-	-	Enter Description	$
		PCO Subtotal	$
		Subcontractor Default Insurance (SDI) (Insert %)	$
		General Liability Insurance Fee (Insert %)	$
		Contractors (CM/GC) Fee (Insert %)	$
		Total Cost of this PCO Request	$
		***Contract Time will be increased (decreased) by	0 Days

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Contractor:	**A/E:**	**Intermountain Health:**
Contractor Firm Contractor Rep. Name - Title	A/E Firm A/E Rep. Name - Title	IHC Health Services, Inc. Owners' Rep. – PM Name
Signature Date	Signature Date	FD&C Project Manager[1] Date
		System Construction Director[2] Date
		FD&C Executive Director, Design & Construction[3] Date

[1] For major and geographical capital projects, FD&C Project Manager to sign.********

[2] System Construction Director to sign when the charge exceeds $40,000 for geographical managed projects, or $200,000 for major capital projects, as outlined in the "*Approval Authority Capital Expenditures Policy*".

[3] Executive Director, Design & Construction to sign when the charge exceeds $200,000 as outlined in the "*Construction Change Order Procedure*".

******PM signatures are required for all PCO's *prior* to work commencing.**

PROPOSAL REQUEST

PR # 001

Project Name:	**Project Name Address Address**	**A/E:**	**A/E**
Bid Package:	**1.0X**	**Date:**	**Date Issued**
Owner:	**IHC Health Services, Inc.**	**PR Page Count:**	**XX**
Intermountain Project #:	**Project ID #**	**PR Prepared By:**	**Name**
FD&C PM:	**PM Name**	**Contractor:**	**Contractor**
PR Description:	**Description**		

Reason For Change (Required):

☐A/E Error ☐A/E Omission ☐A/E Request ☐GC Request ☐Owner/FD&C Request ☐Functional Request

☐Unknown Condition

Please submit a fully itemized list of Construction Costs, with supporting documentation, for any changes in the Construction Costs, Contract Sum, and/or Contract Time incidental to the proposed modifications to the Contract Documents.

THIS IS NOT A CHANGE ORDER, A CONSTRUCTION CHANGE DIRECTIVE OR A NOTICE TO PROCEED WITH THE WORK DESCRIBED IN THE PROPOSED MODIFICATIONS.

DESCRIPTION:

Text

ATTACHMENTS:

Text

Requested by: _____
(Signature) (Printed Name and Title) (Date)

Approved by FD&C PM[1]: _____
(Signature) (Date)

[1] For major and geographical capital projects, FD&C Project Manager to sign.

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REQUEST FOR INFORMATION

RFI # 001

Project Name:	**Project Name** **Address** **Address**	**Contractor:**	**Contractor**
Bid Package:	**1.0X**	**Date:**	**Date Issued**
Owner:	**IHC Health Services, Inc.**	**RFI Page Count:**	**XX**
Intermountain Project #:	**Project ID #**	**RFI Prepared By:**	**Name**
FD&C PM:	**PM Name**	**A/E:**	**A/E**
RFI Description:	**Description**		
Cross Reference:	**ASI #, Drawing Info, etc.**	**RFI Response Date Requested:**	**Date**

☒ ***Contractor Attestation (Required checkbox):*** *The undersigned Contractor has reviewed the Contract Documents and is unable to locate this requested information within the Contract Documents. This RFI requests information, direction, or clarification for this specific item.*

Contractor Signature: *Signature* ***Date:*** *Date*

QUESTION:

Text

RESPONSE:

Text

A/E Response By:	**Name**	**Date:**	**Date**
A/E PM Acknowledgement:	**Name**	**Date:**	**Date**

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Contractor Orientation

Intermountain Healthcare Facilities Management

This orientation is to be read to all workers by the Facility Manager or designee, and a copy is to be given to each worker on the job site.

Safety on the Job Site

Your Safety

Unsafe acts will not be tolerated on the job site. We want you to be as healthy and whole when you go home, as you were when you arrived.

Appropriate PPE will be worn at all times while working on the job site. Ladders and other equipment will be used properly.

Always use the proper lock-out/tag-out (LOTO) procedures and equipment to ensure that you and others are protected from hazardous energy while working. Be aware that energized systems in healthcare facilities can be complex, and your work may affect others in remote areas of the facility. Coordinate any LOTO activity with the Facility Manager and other affected trades.

The Safety of Others

Nothing you do should put others in danger or harm them in any way. Be thoughtful and deliberate about safety.

Your Behavior on the Job Site

How You Should Act

You should come to work with a clean body in clean clothes. You should come to work sober. Attempting to work while under the influence of any drugs or alcohol – even if they are prescribed – can be dangerous to you and others, and is cause for immediate removal from the job site.

Be considerate of others. Remember that others may take offense at things you do, even when you mean no harm. Avoid doing or saying things that may bother or upset others.

No music, no smoking, no cursing, no shouting, no leering, no fighting, no racially or culturally insensitive comments, no suggestive or offensive comments, no propositions, and no soliciting are permitted while you are on the job site.

Phones, Cameras, and Other Communication or Recording Devices

You should not carry on personal communication or phone conversations while on the job site.

You must NEVER photograph, or video or audio record ANYTHING or ANYONE on Intermountain Healthcare property. This will not be tolerated, and in some cases this may violate the law. If work needs to be photographed, have your supervisor or the facilities team on site take the pictures.

On this job site, the person who authorizes photography or recording is: _____.

Where You Should Be on the Property

Parking

Park only in the location identified by the Facility Manager in your orientation. Parking personal vehicles in any other location may result in their removal.

On this job site, the parking location is: _____.

Smoking

Smoking is not allowed on any Intermountain property. If you need to smoke, vape, or use tobacco in other ways, you must leave the property and return when you're done.

Drugs are never allowed.

Break Time

Take breaks only in areas identified by the Facility Manager in your orientation. During breaks do not engage in loud conversation or use offensive language.

On this job site, the break location is: _____.

Meals

The Facility Manager will tell you in your orientation if you are permitted to use the facility cafeteria and dining room during your meal time. Take meals only in areas identified by the Facility Manager in your orientation.

Never take breaks in public areas meant for patients and their guests.

On this job site, the meal location is: _____.

On this job site, the break location is: _____.

When You Should Be on the Property

When you are working, or on the property for work you should not arrive earlier than is necessary for you to assemble your tools and equipment for the day. Arriving very early and 'hanging around' is not permitted. Your supervisor will tell you what time you should arrive at work.

When you are done with the work day, and your tools and equipment are cleaned and put away, and your job site is clean, you should leave the property directly. Staying on the job site after work is not permitted.

Of course, if you are a patient, or are visiting one of our patients, you are always welcome in the public areas of the facility. Do not visit the job site unless you are here for work.

We ask you that while you are here you remember that you may be seen by others as representing your company or ours, and to please comport yourself accordingly.

How a Healthcare Facility May Be Different from Other Jobs Sites

People

The people who come to our hospitals and other facilities come because they feel sick, hurt, scared, or sad. They don't come to see us when everything is going fine. They want to feel safe and comfortable and confident that everything will be better soon.

Many of them are sensitive to noise, dust, fumes, odors, and vibrations. Please do everything you can to control these irritants.

The procedures we do in our facilities frequently require quiet and stillness. Please be sensitive to this and be ready to accommodate requests to stop work briefly or move to a different area of the facility to continue working.

Building Systems

The structure of our hospitals and other facilities is intended to actively work to protect our staff, patients, and visitors in the event of an emergency. This means that you must be very careful about how your work impacts other systems and parts of the building. Some of the rules are strange, but all are important.

Certain walls are intended to stop smoke or fire from spreading because when our buildings catch fire we cannot leave. We continue to care for our patients, perform surgeries, help birth babies, and provide emergency medical care. When working around or through these walls – "rated assemblies" – it is critical that you do so properly.

A pre-inspection by a member of the facility's maintenance team of the area you'll be working in is required so that you can understand where rated assemblies are, and how you must treat them. This also gives you an opportunity to identify existing conditions for which you may not be responsible.

A post-inspection by a member of the facility's maintenance team of the work you've done is required so that you can demonstrate that you've complied with all requirements for maintaining the integrity of our protective rated assemblies.

On this job site, the contact for fire stopping materials is: _____.

Along with rated assemblies, our facilities have very sensitive fire and smoke detection systems, as well as automatic sprinkler systems. If your activities will cause dust or vibration or impact, be aware and mitigate any adverse effect you may have on these systems.

On this job site, the contact for fire alarm systems is: _____.

If your work interrupts or disables any portion of the building's life safety systems, including fire alarm, fire suppression, and emergency egress, you may be required to implement interim life safety measures.

On this job site, the contact for interim life safety is: _____.

Much of our air is exhausted to the outside. If you are working around exhaust fans, you must know what areas the exhaust is coming from. Some exhausts are laden with radioactive elements. Some carry infectious diseases and other germs. Your supervisor will tell you about these areas.

On this job site, the hazardous exhaust areas are: _____.

Many of our patients depend on clean and fresh outside air to be provided to them. Smoking on roofs or around air intakes is strictly forbidden for this reason. If you must operate equipment on roofs or around air intakes, be certain to coordinate your work with the Facility Manager.

On this job site, the sensitive air intakes are: _____.

Much of our equipment may start without notice. Take care to avoid being harmed by unexpected starts, or unexpected discharges of steam, hot water, or chemicals. Unless you are authorized to be working around this equipment you should stay out of these spaces.

All work above the ceiling requires an Above Ceiling Work Permit, and all hot work requires a Hot Work Permit.

On this job site, the contact for Above Ceiling Work Permits is: _____.

On this job site, the contact for Hot Work Permits is: _____.

Infection Control

Because many of our patients are ill, there is a chance that you will be exposed to germs. There is also a chance that you will expose our patients to germs you've brought from outside the hospital. We do our best to keep our physical environment clean and to control all infectious matter.

You can protect yourself by ensuring that your vaccinations are current, and by only going in places you are authorized to go. Wash or sanitize your hands frequently – especially after using the restroom and before eating. Never eat food anywhere except where you are told to have meal breaks. The Plumber's Rule No. 3 applies to everyone in healthcare: Don't bite your fingernails!

Your work may require an Infection Control Risk Assessment. The Facility Manager will help you determine when that is, and will help you through the process. This process helps identify the best ways to keep you and our patients safe from infections and other impediments to healing. Once the assessment is done, be certain to abide by all of its conditions.

On this job site, the infection control contact is: _____.

A Clean Job Site

Throughout the work day, you will be responsible to maintain a reasonably clean job site. This makes it a safer place for you to work. It makes it a safer place for others to work, as well.

At the end of each work day, you will be responsible to leave all materials in an orderly state, remove all waste, scrap, and debris from the site, and leave the area broom clean. All potential hazards will be secured and made as safe as possible.

All construction waste and debris must be disposed of properly. Never use toilets or floor drains for this purpose. Cover all carts while moving debris through the facility, and use tacky mats to control dust tracking over floors.

Our Expectation of Workmanship

It doesn't matter if you're a ventilation mechanic, an electrician, a painter, or a plumber. It doesn't matter if you're installing carpet, or ceiling tiles, or kitchen equipment, or cabinetry. Every piece of our facilities is in place to support the lifesaving and healing work we do.

The hard reality is that someone's life will literally depend on the quality of the workmanship you put into the jobs you do in Intermountain Healthcare facilities.

And it's another hard reality that someone you care for may very likely come to the facilities you helped build. Please do the kind of job you'd trust your loved one's life to.

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CONSTRUCTION SAFETY REQUIRMENTS

I. Outside Contractors and Intermountain Construction Employees performing construction activities on occupied Intermountain Healthcare property shall meet the following requirements. Stand-alone, new construction sites are not covered by these requirements. Outside Contractors will meet additional qualifications through the Supply Chain Organization Supplier Credentialing Procedure.

   a. No work will be performed in any Intermountain Facility without prior approval and coordination with the accountable Facility Engineering Manager or Director.
   b. Each outside contractor will have a Safety Program that complies with 29 CFR 1926 Subpart C. The Safety Program will be in writing.
   c. Any chemical brought onto Intermountain Property must meet the following requirements:
      i. Approved by the facility's Chemical Safety Officer,
      ii. Accompanied by a current material safety data sheet,
      iii. Stored in accordance with the chemical manufacturer's safety requirements in the appropriate labeled container.
      iv. Where the chemical quantity is restricted for Healthcare Occupancies by NFPA 30 or other standards, it is the contractor's responsibility to provide for off-site storage.
      v. The Contractor is responsible to comply with Intermountain's Hazardous Materials policy.
      vi. The Contractor is responsible for the removal of all chemicals from Intermountain Property and for proper disposal in accordance with applicable laws and regulations.
   d. No work will be performed without the completion of an Interim Life Safety and Infection Control Risk Assessment. These risk assessments will cover each phase of the construction project.
   e. In existing facilities, an Asbestos inspection and any necessary abatement will be conducted prior to any renovation or remodel per the Hazmat policy.
   f. Where work will cause noise or vibration, an assessment will be made following facility procedures to mitigate potential hazards to patients.
   g. Above the Ceiling Permits
      i. The Contractor will follow each facility's procedure for obtaining an above the ceiling work permit.
      ii. No work will be performed prior to obtaining this permit.
   h. Hot Work Permits
      i. The Contractor will obtain a Hot Work Permit from Facilities Engineering prior to performing any hot work.
      ii. The Contractor will provide a continuous and qualified fire watch for the duration and location specified by the Facility Engineering Director.
   i. Confined Space Permits
      i. The contractor will coordinate with the Intermountain Facility Engineering Director to assure that all requirements are met and a permit is completed prior to entering a permit required confined space.

j. Control of Airborne Contaminants
    i. The contractor will control all airborne dusts, mists, fumes, and vapors such that there is no exposure to Intermountain employees, patients, or visitors. This includes the generation of contaminants outside the building.
    ii. If necessary, work will be conducted after hours to minimize potential exposures to staff, patients, and members of the public.
k. Personal Protective Equipment.
    i. PPE for head, eye, face, hand, foot, and respiratory protection is the responsibility of the contractor, and will be provided and worn as necessary for the exposure, except as follows:
        1. Hard Hats and Safety Glasses are required to be worn at all times when in the construction area. Hard hats may be removed when working in areas where the suspended ceiling grid has been completely installed.
    ii. Fall Protection is the responsibility of the contractors and shall meet all 29 CFR 1926 requirements of the applicable Subparts.

Intermountain Health

RESPONSIBILITY MATRIX

Updated February 13, 2023

The following list identifies the majority of the items that are to be included in the capital project build-out. All Owner items need to be coordinated with A/E (Design Team), Contractor, and Owner (Facility Design & Construction and Supply Chain Facility Equipment Planners). For OFOI or OFCI items, Contractor is required to track equipment on construction schedule and to notify Owner of required delivery times taking into account for equipment lead times.

ITEM	OWNER/VENDOR	NOTES	ADDITIONAL NOTES		
OFOI - (Owner Furnished / Owner Installed)	**(Coordinate location of items with Owner and track within construction schedule)**		Data	Power	Backing
Art	Owner / Owner (Alpine Art)	All artwork to be coordinated with Dan Kohler. Provide power and backing to required artwork.			
Audio/Video (A/V)	Owner / Owner	Intermountain SCO will source & supply the A/V system including specialized cabling (e.g. HDMI, etc). Refer to CFCI section for Contractor requirements. A/E to identify locations on drawings, coordinate with Owner. Contractor to provide infrastructure, back boxes, conduits, pathways and cabling (from wall side back).	Yes	Yes	
Brochure Racks	Owner / Owner	Contractor to provide proper backing.			Yes
Cash (Manual) Drawer	Owner / Owner	Identify locations and coordinate with point-of-sale equipment vendor.			Yes
Chart Racks	Owner / Owner (Midwest)	Contractor to provide proper backing.			Yes
Clinical Garbage Cans (Clinical, Office, PT, Etc.)	Owner / Owner				
Computers, Printers, Scanners, Keyboards, Mice, etc.	Owner / Owner	In-ceiling & wall mounts, conduits and boxes mounted by Contractor. Computers to be All-in-One, typ. in IMG exam rooms.	Yes	Yes	Yes
Copiers, fax	Owner / Owner	A/E to locate where copy/fax/printer is not visual clutter.	Yes	Yes	
Cup Dispensers	Owner / Owner				
Emergency Evacuation Medical Sled (Med Sled)	Owner / Owner	A/E to coordinate location with Owner.			
Exam Tables	Owner / Owner			Yes	
Infant/Pediatric Security System	Owner / Owner (Totguard)	A/E to identify locations on drawings. This system is to be coordianted with Owner, Women's and Children's Operations, Clinical Programs and Security.	Yes	Yes	
IV Hangar	Owner / Owner	A/E to identify locations on drawings, coordinate with Owner. Backing to be coordinated, if required.			
Keyboard Trays	Owner / Owner				
Magnetic Marker Boards, Cork Boards, Huddle Boards, Idea Tracking Boards, etc.	Owner / Owner (Midwest)	A/E to coordinate location with Owner.			Yes
Moveable Metal Shelving	Owner / Owner				
Nurse Notification Call (NNC) System & Devices (Hospital Campus)*	Owner / Owner (Hillrom)	Hospital local facility team to work with Supply Chain Facility Equipment Planning team to contract directly with Nurse Notification Call (NNC) system vendor (Hillrom) for devices, equipment, monitors, etc. A/E to coordinate with Owner and Hillrom for all NNC infrastructure required to support the device locations and types designated by Hillrom on their site specific drawings. Hillrom site specific drawings to be coordinted and included in the A/E Contract Documents. Contractor to provide all infrastructure including conduits, back boxes, cabling (e.g. home-runs to RCB, RCB to device, device to device, etc.), etc. for all NNC devices (e.g. RCB, GSR-10, room devices, etc.). The cabling for the NNC system will be coordinated and installed by the Contractor/Subcontractor (i.e. low voltage sub). Contractor to coordinate with Hillrom. *Where an existing non-Intermountain standard NNC system exists (e.g., Rauland), Clinical Engineering must be engaged to determine if this existing system will continue or be replaced with the Intermountain standard NNC system. Please also coordinate with CTIS and Facility Equipment Planners. When an existing NNC system is determined to continue, this NNC system will fall under the CFCI section, where the A/E will design the system and the Contractor will provide/furnish and install the system.	Yes; see CFCI	Yes; see CFCI	
PACS	Owner / Owner				
Patient Monitoring System & Devices (Hospital Campus)	Owner / Owner	Hospital local facilities to work with Supply Chain Facility Equipment Planning team to contract directly with Patient Monitoring vendors for devices, equipment, monitors, etc. (from wall side out). A/E to identify locations on drawings, coordinate with Owner. Contractor to provide all infrastructure including conduits, back boxes, and home-run cabling from Patient Monitoring devices to TEC/TDR rooms that connect to Intermountain's network (Intermountain Siemon certified installer low voltage subcontractor to install). The Patient Monitoring system device to device cabling is by Vendor.	Yes	Yes	
Radiology Equipment	Owner / Owner (See subject matter expert list)	A/E responsible to coordinate final site equipment drawings into Construction Documents from Owner's Vendor.	Yes	Yes	
Receptionist Desk	Owner / Owner (Midwest & Steelcase)				
Recliners / Draw Chairs	Owner / Owner				
Sharps Disposal Container	Owner / Owner (Stericycle)	A/E to identify locations on drawings, coordinate with Owner. Backing to be coordinated, if required.			
Signage - Exterior	Owner / Owner (KB Signs, Trademark, YESCO)	Provide power and data to required exterior signage. Provide circuits for above ceiling signs. Coordinate thru-wall conduit sleeves with weather barrier. A/E to coordinate traffic signage and Contractor to install. Intermountain Logo Signs - (2) 20A Circuits - May vary. InstaCare and other Signs - (1) 20 A Circuits - May vary.	Yes	Yes	Yes
Signage - Interior (including Code Signage)	Owner / Owner (Intermountain Sign Shop, Scribbley, Hightech)	Provide power to required signage. Contractor to track in schedule and notify Owner for when Code Required signage is required to be installed.			

Staff Assist Notification Call System & Devices (Medical Group Clinics on hospital campuses to match NNC system)*	Owner / Owner (Hillrom)	Hospital local facility/IMG Ops team to work with Supply Chain Facility Equipment Planning team to contract directly with Staff Assist Notification Call system vendor (Hillrom) for devices, equipment, monitors, etc. (from wall side out). Staff Assist Notification system to be coordinated with Hospital Campus NNC system, as applicable, Medical Group Strategic Planner, and IMG Operations Officer. A/E to coordinate with Owner and Hillrom for all Staff Assist Notification Call system infrastructure required to support the device locations and types designated by Hillrom on their site specific drawings. Hillrom site specific drawings to be coordinted and included in the A/E Contract Documents. Contractor to provide all infrastructure including conduits, back boxes, cabling (e.g. home-runs to RCB, RCB to device, device to device, etc.), etc. for all NNC and Staff Assist Notification Call devices (e.g. RCB, GSR-10, etc.). The cabling for the NNC and Staff Assist Notification Call system will be coordinated and installed by the Contractor/Subcontractor (i.e. low voltage sub). Contractor to coordinate with Hillrom. *Where an existing non-Intermountain standard NNC system exists (e.g., Rauland), Clinical Engineering must be engaged to determine if this existing system will continue or be replaced with the Intermountain standard NNC system. Please also coordinate with CTIS and Facility Equipment Planners. When an existing NNC system is determined to continue, this NNC system will fall under the CFCI section, where the A/E will design the system and the Contractor will provide/furnish and install the system.	Yes; see CFCI	Yes; see CFCI	
Staff Assist Notification Call System & Devices (Stand-alone Medical Group Clinics)*	Owner / Owner (Hillrom)	IMG Ops team to work with Supply Chain Facility Equipment Planning team to contract directly with Staff Assist Notification Call system vendor (Hillrom) for devices, equipment, monitors, etc. (from wall side out). Staff Assist Notification Call system to be coordinated with Medical Group Strategic Planner and Operations Officer. A/E to coordinate with Owner and Hillrom for all Staff Assist Notification Call system infrastructure required to support the device locations and types designated by Hillrom on their site specific drawings. Hillrom site specific drawings to be coordinted and included in the A/E Contract Documents. Contractor to provide all infrastructure including conduits, back boxes, cabling (e.g. home-runs to RCB, RCB to device, device to device, etc.), etc. for all Staff Assist Notification Call devices (e.g. RCB, GSR-10, etc.). The cabling for the Staff Assist Notification Call system will be coordinated and installed by the Contractor/Subcontractor (i.e. low voltage sub). Contractor to coordinate with Hillrom. *Where an existing non-Intermountain standard NNC system exists (e.g., Rauland), Clinical Engineering must be engaged to determine if this existing system will continue or be replaced with the Intermountain standard NNC system. Please also coordinate with CTIS and Facility Equipment Planners. When an existing NNC system is determined to continue, this NNC system will fall under the CFCI section, where the A/E will design the system and the Contractor will provide/furnish and install the system.	Yes; see CFCI	Yes; see CFCI	
Supply Area Panels	Owner / Owner	Contractor to provide proper backing, coordinate with Owner.			Yes
Systems Furniture (including demountable partitions)	Owner / Owner (Midwest & Steelcase)	Coordinate modesty panels with elec. outlets. Sit/Stand desks to have modesty panel on front. Attention to be given to cord management. A/E to coordinate data and power with Midwest.	Yes	Yes	
Televisions, Digital Projectors, similar devices, etc.	Owner / Owner	These items to be provided by Owner, but A/E to coordinate locations and infrastructure. Contractor to refer to OFCI section.	Yes	Yes	Yes

OFCI - (Owner Furnished / Contractor Installed)	**(Coordinate location of items with Owner and track within construction schedule)**		Data	Power	Backing
Alertus - Mass Notification System (Public Areas)	Owner (Alertus) / Contractor	A/E to identify locations on drawings, coordinate with Owner.	Yes	Yes	
Apron Hooks/Rack (Heavy Duty in Radiology)	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.			Yes
Automated External Defibrillator (AED)	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner, A/E to coordinate recess, semi-recessed, or surface mount options with Owner.			Yes
Bio Safety Cabinet	Owner / Contractor	A/E to locate equipment on drawings and coordinate all connections. Contractor to track on construction schedule and coordinate final connections when equipment has been installed.		Yes	
Boom and Injector Ceiling Mounting Plates (Equipment, Lighting, Anesthesia, Injection, etc.)	Owner / Contractor	A/E to coordinate with Owner and Owner's selected equipment Vendor; A/E to identify boom locations on drawings, coordinate with Owner; A/E to coordinate the design of the boom support structure into drawings. Final site specific equipment drawings from Vendor to be coordinated with Construction Documents. Contractor to coordinate with Owner and install boom support structure and boom mounting plates. Contractor to coordinate with Owner for ordering and install of boom mounting plates.	Yes	Yes	Yes
Building Alarms / Medication Refrigerator Alarm / Pharmacy Alarm System	Owner / Contractor	A/E to identify locations and infrastructure on drawings, coordinate with Owner. Contractor to provide conduit and infrastructure into accessible ceiling for access from equipment and/or devices. Local Facility to contract with alarm company for alarm, wire, and monitoring.		Yes	
Chain Hoist Industrial Lift	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.		Yes	Yes
Clinical Clocks	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner. Contractor to coordinate with Owner for ordering and install coordination.		Yes	Yes
Clinical Storage Cabinet (Flammable Items)	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.			
Cubicle Curtains & Tracks	Owner (Medline) / Contractor	A/E to identify locations on drawings, coordinate with Owner. Contractor to coordinate with Owner for ordering and install coordination.			
Diagnostic Board including Wall Mount Replacable Tips (Otoscope / Ophthalmoscope)	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.		Yes	Yes
Diaper Changing Station	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.			Yes
Digital Projector Mounts, TV Mounts, & Computer Mounts (Ergotron Brackets/Mounts, etc.)	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner. Contractor to coordinate with Owner for ordering and install coordination. In-ceiling & wall mounts, conduits and boxes provide and installed by Contractor A/E to coordinate A/V requirements. Contractor to pull required A/V cabling.	Yes	Yes	Yes
Distributed Antenna System (DAS) including Public Safety	Owner (DAS vendor selected and managed by Intermountain CTIS/Telecom) / Contractor	A/E to locate infrastructure on drawings to simplify the DAS install. Contractor to track on construction schedule and coordinate DAS install with Owner's Vendor.			
Exercise Rack Wall Rack	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.			Yes
Face Mask Dispenser (Wall Mount)	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.			Yes
Grossing Workstation	Owner / Contractor	A/E to locate equipment on drawings and coordinate all connections. Contractor to track on construction schedule and coordinate final connections when equipment has been installed.	Yes	Yes	Yes
Hand Sanitizer Dispensers (Avagard)	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.			

Hoods (Chemical Soak Station, Ranges, Horizontal Laminar Flow, and similar Hoods)	Owner / Contractor	A/E to identify locations on drawings, including infrastructure requirements, coordinate with Owner.		Yes	Yes
Ice Machine Dispenser (Undercounter, Countertop, etc.)	Owner / Contractor	A/E to identify locations on drawings, including infrastructure requirements, coordinate with Owner.		Yes	
iCentra Tracking Boards	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.	Yes	Yes	Yes
IV Track	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner. Backing to be coordinated, if required.			Yes
Kitchen Range (Electric)	Owner / Contractor	A/E to identify locations on drawings, including infrastructure requirements, coordinate with Owner.		Yes	
Laundry Dryer, Washer (single, stacked, disinfector)	Owner / Contractor	A/E to identify locations on drawings, including infrastructure requirements, coordinate with Owner.		Yes	
Medication Return Bin	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner. This is a pass-thru unit for medication return accessed from public corridor into a secured locked room.			Yes
OR Clocks	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner. Contractor to coordinate with Owner for ordering and install coordination.	Yes	Yes	Yes
Paper Towel Dispensers	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.			
Pass-thru Cleanroom Chamber	Owner / Contractor	A/E to identify locations on drawings, including infrastructure requirements, coordinate with Owner. Perimeter of each pass-thru unit must be sealed to maintain space pressurization.		Yes	Yes
Patient Lifts	Owner (Liko, subsidiary of Hillrom) / Contractor	A/E to identify locations on drawings, coordinate with Owner. A/E to design required support structure for Contractor to install for necessary Liko patient lift connections (e.g. pendant / rails / etc). Contractor to coordinate shop drawings and installation requirements prior with Liko. Connect to equipment branch if provided.		Yes	
Personal Protection Dispensers (gloves, gowns, masks, shoe covers, etc.)	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.			Yes
Pharmaceutical Pass-thru Refrigerator	Owner / Contractor	A/E to identify locations on drawings, including infrastructure requirements, coordinate with Owner. Perimeter of each pass-thru unit must be sealed to maintain space pressurization.		Yes	
Pharmacy Dispensing Water Treatment System	Owner / Contractor	A/E to identify locations on drawings, including infrastructure requirements, coordinate with Owner.		Yes	Yes
Procedure Lights	Owner / Contractor	A/E to coordinate with Owner and Owner's selected equipment Vendor; A/E to identify locations on drawings, coordinate with Owner; A/E to coordinate the design of the procedure light support structure into drawings. Contractor to provide and install procedure light support structure.		Yes	Yes
Radiation Protection Calculations and Certification	Owner / Contractor	A/E to coordinate with Owner in the design phase for coordinating with Medical Physicists Consultants or others, when required. Contractor to coordinate prior to Gyp. Bd. install.			Yes
Sanitary Napkin Dispensers/Receptacles	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.			
Scrub Brush Dispenser (Wall Mount)	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.			Yes
Scrub Sinks & Carriers	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner. Contractor to coordinate with Owner for ordering and for install coordination.			Yes
Shower Curtains & Rods	Owner (Medline) / Contractor	A/E to identify locations on drawings, coordinate with Owner. Contractor to coordinate with Owner for ordering and install coordination.			
Soap Dispensers	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.			
Stadiometers, Recessed Scales	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner; coordinate power and floor recesses.		Yes	
Time Clocks	Owner / Contractor	Conduit and boxes by Contractor, Coordinate location with Owner.	Yes	Yes	
Tissue Dispenser (Wall Mount)	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.			Yes
Toilet Paper Dispensers	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.			
Undercounter Dishwasher	Owner / Contractor	A/E to locate equipment on drawings and coordinate all connections. Contractor to track on construction schedule and coordinate final connections when equipment has been installed.		Yes	
UPS (MRI, Data Room, CPU, or other similar equipment)	Owner / Contractor	A/E to identify equipment locations on drawings, coordinate with Owner.	Yes	Yes	Yes
Wall Mount Basket for Cuff	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.			Yes
Wall Mount Bracket for Clinical Monitor (sizes vary)	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.		Yes	Yes
Wall Mount Bracket for Disinfectant Wipes	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.			Yes
Wall Mount Bracket for Emesis Bags	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.			Yes
Wall Mount Bracket for Eyewear/Eyeshield Dispenser	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.			Yes
Wall Mount Bracket for Patient Transfer Device, Patient Evacuation Device (Med Sled),	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.			Yes
Wall Mount Bracket for Suction Canister	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.			Yes
Wall Mount for Area Radiation Monitor	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.		Yes	Yes
Wall Mount for Mops, Brooms, etc.	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.			Yes
Wall Mount for Phlebotomy Station (Infant)	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.			Yes
Wall Mount Hair Dryer	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.		Yes	Yes
Wall Mounted Chemical Spill Kit	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.			Yes
Wall Mounted Modular Storage Shelving	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.			Yes
Wall Mounted Shelving	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.			Yes
Wall Mounted Thermometer (Temporal Artery, Digital, etc.)	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.			Yes
Zip Line Execiser Kit	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.			Yes

CFCI - (Contractor Furnished / Contractor Installed)	**(Coordinate location of items with A/E Design Team and track within construction schedule)**		Data	Power	Backing
Access Control, Card Readers (Lenel)	Contractor / Contractor (AlphaCorp/Convergint)	A/E to identify locations on drawings, coordinate with Owner.	Yes	Yes	
Audio/Video (A/V)	Contractor / Contractor	Intermountain SCO will source & supply the A/V system including specialized cabling (e.g. HDMI, etc). A/E to identify locations on drawings, coordinate with Owner. Contractor to provide infrastructure, back boxes, conduits, pathways and misc. cabling (from wall side back).	Yes	Yes	
Blinds/Shades (manual and powered)	Contractor / Contractor	A/E to identify locations on drawings, coordinate with Owner.		Yes	
Coat Hooks (Rest rooms/Showers, Exam rooms, Offices/Workstations only)	Contractor / Contractor	A/E to identify locations on drawings.			Yes
Communication Boards (e.g. Patient Rooms)	Contractor / Contractor	A/E to identify locations on drawings, coordinate with Owner. If boards are electronic, then data and power should also be provided.			Yes
Communication Cabling	Contractor / Contractor	A/E to identify locations on drawings, coordinate with Owner. See Intermountain Design Guidelines and Construction Standards for additional information.			
Emergency Phones, Kiosks - Exterior	Contractor / Contractor	A/E to identify locations on drawings, coordinate with Owner. Conduit and boxes by Contractor.	Yes	Yes	Yes
Emergency Shower Station / Eye Wash Station	Contractor / Contractor	A/E to identify locations on drawings, coordinate with Owner. These shall meet ANSI and Owner requirements.			Yes
Fire Extinguishers	Contractor / Contractor	A/E to identify types and locations on drawings, coordinate with Owner. 10 lbs. minimum - refer to Intermountain Design Guidelines & Construction Standards.			Yes
Grab Bars (Rest rooms, Radiology, Exam rooms, etc.)	Contractor / Contractor	A/E to identify locations on drawings.			Yes
Intrusion Detection	Contractor / Contractor	A/E to identify locations on drawings, coordinate with Owner.			
Med Gas Certification	Contractor / Contractor	Contractor to coordinate Vendor with Owner			

Mirrors (Rest rooms, Exams, Radiology, Rehab, etc.)	Contractor / Contractor	A/E to identify locations on drawings, coordinate with Owner.			Yes
Nurse Notification Call (NNC) System - Low Voltage Cabling (Hospital Campus)*	Contractor / Contractor (Hillrom)	A/E to coordinate with Owner and Hillrom for all NNC infrastructure required to support the device locations and types designated by Hillrom on their site specific drawings. Hillrom site specific drawings to be coordinted and included in the A/E Contract Documents. Contractor to provide all infrastructure including conduits, back boxes, cabling (e.g. home-runs to RCB, RCB to device, device to device, etc.), etc. for all NNC devices (e.g. RCB, GSR-10, etc.). The cabling for the NNC system will be coordinated and installed by the Contractor/Subcontractor (i.e. low voltage sub). Contractor to coordinate with Hillrom. *Where an existing non-Intermountain standard NNC system exists (e.g., Rauland), Clinical Engineering must be engaged to determine if this existing system will continue or be replaced with the Intermountain standard NNC system. Please also coordinate with CTIS and Facility Equipment Planners. When an existing NNC system is determined to continue, this NNC system will fall under the CFCI section, where the A/E will design the system and the Contractor will provide/furnish and install the system.	Yes	Yes	
Patient Monitoring System & Devices (Hospital Campus)	Contractor / Contractor	A/E to identify locations on drawings, coordinate with Owner. Contractor to provide all infrastructure including conduits, back boxes, and home-run cabling from Patient Monitoring devices to TEC/TDR rooms that connect to Intermountain's network (Intermountain Siemon certified installer low voltage subcontractor to install). The Patient Monitoring system device to device cabling is by Vendor.	Yes	Yes	Yes
Plumbing Shrouds	Contractor / Contractor				
Pneumatic Tube Systems	Contractor / Contractor (SwissLog, Atreo Group, or other approved)	A/E to identify locations on drawings, coordinate with Owner. If SwissLog, verify pricing is per Intalere (Amerinet) Contract Agreement. Design assistance fees are included in this agreement.	Yes	Yes	
Radiation Protection (Lead) Installation - (ex. Cath Lab, CT Scanner, X-Ray)	Contractor / Contractor	A/E to identify locations on drawings and coordinate with Owner's Vendor on the required shielding thicknesses.			Yes
Radiofrequency/Magnetic (RF) Shielding Installation - MRI	Contractor / Contractor	A/E to coordinate with Owner in the design phase and coordinate appropriate shielding.			Yes
Security Cameras, Video Surveillance	Contractor / Contractor (AlphaCorp/Convergint)	A/E to identify locations on drawings, coordinate with Owner.	Yes		
Staff Assist Notification Call System - Low Voltage Cabling (Medical Group Clinics on hospital campuses to match NNC system)*	Contractor / Contractor (Hillrom)	A/E to coordinate with Owner and Hillrom for all Staff Assist Notification Call system infrastructure required to support the device locations and types designated by Hillrom on their site specific drawings. Hillrom site specific drawings to be coordinted and included in the A/E Contract Documents. Contractor to provide all infrastructure including conduits, back boxes, cabling (e.g. home-runs to RCB, RCB to device, device to device, etc.), etc. for all NNC and Staff Assist Notification Call devices (e.g. RCB, GSR-10, etc.). The cabling for the NNC and Staff Assist Notification Call system will be coordinated and installed by the Contractor/Subcontractor (i.e. low voltage sub). Contractor to coordinate with Hillrom. *Where an existing non-Intermountain standard NNC system exists (e.g., Rauland), Clinical Engineering must be engaged to determine if this existing system will continue or be replaced with the Intermountain standard NNC system. Please also coordinate with CTIS and Facility Equipment Planners. When an existing NNC system is determined to continue, this NNC system will fall under the CFCI section, where the A/E will design the system and the Contractor will provide/furnish and install the system.	Yes	Yes	
Staff Assist Notification Call System - Low Voltage Cabling (Stand-alone Medical Group Clinics)*	Contractor / Contractor (Hillrom)	A/E to coordinate with Owner and Hillrom for all Staff Assist Notification Call system infrastructure required to support the device locations and types designated by Hillrom on their site specific drawings. Hillrom site specific drawings to be coordinted and included in the A/E Contract Documents. Contractor to provide all infrastructure including conduits, back boxes, cabling (e.g. home-runs to RCB, RCB to device, device to device, etc.), etc. for all Staff Assist Notification Call devices (e.g. RCB, GSR-10, etc.). The cabling for the Staff Assist Notification Call system will be coordinated and installed by the Contractor/Subcontractor (i.e. low voltage sub). Contractor to coordinate with Hillrom. *Where an existing non-Intermountain standard NNC system exists (e.g., Rauland), Clinical Engineering must be engaged to determine if this existing system will continue or be replaced with the Intermountain standard NNC system. Please also coordinate with CTIS and Facility Equipment Planners. When an existing NNC system is determined to continue, this NNC system will fall under the CFCI section, where the A/E will design the system and the Contractor will provide/furnish and install the system.	Yes	Yes	
Support Bracing/Structure for Radiology and similar equipment	Contractor / Contractor	A/E to coordinate with Owner and Owner's selected Radiology equipment Vendor; A/E to coordinate the design of the support bracing/structure into drawings. Final site specific equipment drawings from Vendor to be coordinated with Construction Documents. Contractor to coordinate with Owner for install of support structure.	Yes	Yes	Yes
TV System Distribution	Contractor / Contractor	A/E to identify locations on drawings, coordinate with Owner.			
Voice/Data Cabling (all horizontal cabling)	Contractor / Contractor (Cache Valley Elec., IES Commercial, Data Tech Professionals, Hunt Electric, and others listed in Intermountain Div. 27)	Refer to Division 27 in the Intermountain Design Guidelines and Construction Standards. Coordinate with Owner/User on connections, pairs of fiber/copper, conduits, inner-ducts, etc.	Yes		
Wall Protection (Incl. Bumper and Corner Guards)	Contractor / Contractor	A/E to identify locations on drawings, coordinate with Owner. Backing should be included where heavy use/damage may occur.			

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TAX EXEMPTION CERTIFICATE

PART 1 - GENERAL

1.1 SUMMARY

A. Construction materials purchased by or on behalf of **Intermountain Healthcare** *may be* exempt from Utah sales and use taxes. Tax Exempt **Form TC-721** must be used by vendors when purchasing construction materials for **Intermountain Healthcare** projects. A copy of Form TC-721, with the Owner's pertinent tax information, follows this cover page.

Utah State Tax Commission • 210 N 1950 W • Salt Lake City, UT 84137

Exemption Certificate

(Sales, Use, Tourism and Motor Vehicle Rental Tax)

TC-721
Rev. 11/18

Name of business or institution claiming exemption (purchaser)		Telephone number	
IHC Health Services, Inc.		801.442.2000	
Street address	City	State	ZIP Code
36 South State Street, Suite 2200	Salt Lake City	UT	84111
Authorized signature	Name (please print)	Title	
	Brian Deppe	Corporate Tax Director	
Name of Seller or Supplier:		Date	
Sales Tax License Number: 11990296-013-STC		***Required for all exemptions marked with an asterisk (*)***	

The signer of this certificate MUST check the box showing the basis for which the exemption is being claimed.

DO NOT SEND THIS CERTIFICATE TO THE TAX COMMISSION
Keep it with your records in case of an audit.

For purchases by government, Native American tribes and public schools, use form TC-721G.

***☐ Resale or Re-lease**
I certify I am a dealer in tangible personal property or services that are for resale or re-lease. If I use or consume any tangible personal property or services I purchase tax free for resale, or if my sales are of food, beverages, dairy products and similar confections dispensed from vending machines (see Rule R865-19S-74), I will report and pay sales tax directly to the Tax Commission on my next sales and use tax return.

***☒ Religious or Charitable Institution**
I certify the tangible personal property or services purchased will be used or consumed for essential religious or charitable purposes. **This exemption can only be used on purchases totaling $1,000 or more, unless the sale is pursuant to a contract between the seller and purchaser.**

☐ Construction Materials Purchased for Religious and Charitable Organizations
I certify the construction materials are purchased on behalf of a religious or charitable organization and that they will be installed or converted into real property owned by the religious or charitable organization.
Name of religious or charitable organization: _____
Name of project: _____

***☐ Fuels, Gas, Electricity**
I certify all natural gas, electricity, coal, coke, and other fuel purchased will be used for industrial use only and not for residential or commercial purposes.

***☐ Machinery and Equipment and Normal Operating Repair or Replacement Parts Used in a Manufacturing Facility, Mining Activity, Web Search Portal or Medical Laboratory**
I certify the machinery and equipment, normal operating repair or replacement parts, or materials (except office equipment or office supplies) are for use in a Utah manufacturing facility described in SIC Codes 2000-3999 or a NAICS code within NAICS Sector 31-33; in a qualifying scrap recycling operation; in a co-generation facility placed in service on or after May 1, 2006; in the operation of a Web search portal by a new or expanding business described in NAICS Code 518112; in a medical laboratory described in NAICS Code 621511; or in a business described in NAICS 212, Mining (except Oil and Gas), or NAICS 213113, Support Activities for Coal Mining, NAICS 213114, Support Activities for Metal Mining, or NAICS 213115, Support Activities for Nonmetallic Minerals (except Fuels) Mining. For a definition of exempt mining equipment, see Utah Code §59-12-104(14).

***☐ Machinery and Equipment and Normal Operating Repair or Replacement Parts Used in an Electronic Payment Service**
I certify the machinery and equipment and normal operating repair or replacement parts have an economic life of three years or more and are for use in the operation of an electronic payment service described in NAICS Code 522320.

***☐ Machinery or Equipment Used by Payers of Admissions or User Fees**
I certify that: (1) the machinery or equipment has an economic life of three or more years and will be used by payers of admissions or user fees (Utah Code §59-12-103(1)(f)); (2) the buyer is in the amusement, gambling or recreation industry (NAICS Subsector 713); and (3) at least 51 percent of the buyer's sales revenue for the previous calendar quarter came from admissions or user fees.

***☐ Refinery Machinery, Equipment and Normal Repair or Replacement Parts**
I certify the machinery, equipment, normal operating repair parts, catalysts, chemicals, reagents, solutions or supplies are for the use of a refiner who owns, leases, controls or supervises a refinery (see Utah Code §63M-4-701) located in Utah.

***☐ Pollution Control Facility**
I certify our company has been granted a "Certification of Pollution Control Facilities" as provided for by Utah Code §§19-12-101 - 19-12-305 by either the Air Quality Board or the Water Quality Board. I further certify each item of tangible personal property purchased under this exemption is qualifying.

***☐ Municipal Energy**
I certify the natural gas or electricity purchased: is for resale; is prohibited from taxation by federal law, the U.S. Constitution, or the Utah Constitution; is for use in compounding or producing taxable energy; is subject to tax under the Motor and Special Fuel Tax Act; is used for a purpose other than as a fuel; is used by an entity exempted by municipal ordinance; or is for use outside a municipality imposing a municipal energy sales and use tax. The normal sales tax exemptions under Utah Code §59-12-104 do not apply to the Municipal Energy Sales and Use Tax.

***☐ Short-term Lodging Consumables**
I certify the tangible personal property is consumable items purchased by a lodging provider as described in Utah Code §59-12-103(1)(i).

*☐ **Direct Mail**
I certify I will report and pay the sales tax for direct mail purchases on my next Utah *Sales and Use Tax Return.*

*☐ **Commercial Airlines**
I certify the food and beverages purchased are by a commercial airline for in-flight consumption; or, any parts or equipment purchased are for use in aircraft operated by common carriers in interstate or foreign commerce.

*☐ **Commercials, Films, Audio and Video Tapes**
I certify that purchases of commercials, films, prerecorded video tapes, prerecorded audio program tapes or records are for sale or distribution to motion picture exhibitors, or commercial television or radio broadcasters. If I subsequently resell items to any other customer, or use or consume any of these items, I will report any tax liability directly to the Tax Commission.

*☐ **Alternative Energy**
I certify the tangible personal property meets the requirements of Utah Code §59-12-104 and is leased or purchased by or for an alternative energy electricity production facility, a waste energy production facility, or a facility that produces fuel from alternative energy.

*☐ **Locomotive Fuel**
I certify this fuel will be used by a railroad in a locomotive engine.

*☐ **Research and Development of Alternative Energy Technology**
I certify the tangible personal property purchased will be used in research and development of alternative energy technology.

*☐ **Life Science Research and Development Facility**
I certify that: (1) the machinery, equipment and normal operating repair or replacement parts purchased have an economic life of three or more years for use in performing qualified research in Utah; or (2) construction materials purchased are for use in the construction of a new or expanding life science research and development facility in Utah.

*☐ **Mailing Lists**
I certify the printed mailing lists or electronic databases are used to send printed material that is delivered by U.S. mail or other delivery service to a mass audience where the cost of the printed material is not billed directly to the recipients.

*☐ **Semiconductor Fabricating, Processing or Research and Development Material**
I certify the fabricating, processing, or research and development materials purchased are for use in research or development, manufacturing, or fabricating of semiconductors.

*☐ **Telecommunications Equipment, Machinery or Software**
I certify these purchases or leases of equipment, machinery, or software, by or on behalf of a telephone service provider, have a useful economic life of one or more years and will be used to enable or facilitate telecommunications; to provide 911 service; to maintain or repair telecommunications equipment; to switch or route telecommunications service; or for sending, receiving, or transporting telecommunications service.

*☐ **Ski Resort**
I certify the snow-making equipment, ski slope grooming equipment or passenger rope-ways purchased are to be paid directly with funds from the ski resort noted on the front of this form.

*☐ **Aircraft Maintenance, Repair and Overhaul Provider**
I certify these sales are to or by an aircraft maintenance, repair and overhaul provider for the use in the maintenance, repair, overhaul or refurbishment in Utah of a fixed-wing, turbine-powered aircraft that is registered or licensed in a state or country outside Utah.

☐ **Leasebacks**
I certify the tangible personal property leased satisfies the following conditions: (1) the property is part of a sale-leaseback transaction; (2) sales or use tax was paid on the initial purchase of the property; and, (3) the leased property will be capitalized and the lease payments will be accounted for as payments made under a financing arrangement.

☐ **Film, Television, Radio**
I certify that purchases, leases or rentals of machinery or equipment will be used by a motion picture or video production company for the production of media for commercial distribution.

☐ **Prosthetic Devices**
I certify the prosthetic device(s) is prescribed by a licensed physician for human use to replace a missing body part, to prevent or correct a physical deformity, or support a weak body part. This is also exempt if purchased by a hospital or medical facility. (Sales of corrective eyeglasses and contact lenses are taxable.)

☐ **Out-of-State Construction Materials**
I certify this tangible personal property, of which I am taking possession in Utah, will be taken out-of-state and will become part of real property located in a state that does not have sales tax, is taxed at a lower rate, or does not allow credit for tax paid to Utah. I will report the tax on my next Utah return at the lower of the Utah rate where the tangible personal property was purchased or the rate of the location where the tangible personal property is converted to real property in the other state if the other state allows a credit for tax paid to Utah.

☐ **Agricultural Producer**
I certify the items purchased will be used primarily and directly in a commercial farming operation and qualify for the Utah sales and use tax exemption. **This exemption does not apply to vehicles required to be registered.**

☐ **Tourism/Motor Vehicle Rental**
I certify the motor vehicle being leased or rented will be temporarily used to replace a motor vehicle that is being repaired pursuant to a repair or an insurance agreement; the lease will exceed 30 days; the motor vehicle being leased or rented is registered for a gross laden weight of 12,001 pounds or more; or, the motor vehicle is being rented or leased as a personal household goods moving van. This exemption applies only to the tourism tax (up to 7 percent) and the short-term motor vehicle rental tax (Transportation Corridor Funding – 2.5 percent) – not to the state, local, transit, zoo, hospital, highways, county option or resort sales tax.

☐ **Textbooks for Higher Education**
I certify that textbooks purchased are required for a higher education course, for which I am enrolled at an institution of higher education, and qualify for this exemption. An institution of higher education means: the University of Utah, Utah State University, Utah State University Eastern, Weber State University, Southern Utah University, Snow College, Dixie State University, Utah Valley University, Salt Lake Community College, or the Utah System of Technical Colleges.

*** Purchaser must provide sales tax license number in the header on page 1.**

NOTE TO PURCHASER: You must notify the seller of cancellation, modification, or limitation of the exemption you have claimed.

Questions? Email **taxmaster@utah.gov**, or call 801-297-2200 or 1-800-662-4335.

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BID FORM

TO: IHC **Health Services, Inc.** (Intermountain Healthcare)
Facility Design and Construction (FD&C)
36 South State Street, 16th Floor
Salt Lake City, Utah 84111-1486

Attention: Jody Cavazos
Email: Jody.Cavazos@imail.org

PROJECT: **Intermountain Healthcare, Alta View Clinic, ENT & General Surgery Clinics**
9450 South 1300 East, Sandy, Ut 84094

NAME OF BIDDER: _____

BIDDER ADDRESS: _____

DATE:_____

The undersigned, in compliance with your Invitation To Bid, having examined the Drawings and Specifications (Contract Documents) and related documents and the site of the proposed work and being familiar with all of the conditions surrounding the construction of the proposed project, including the availability of labor, hereby propose to furnish all labor, materials, services, equipment and appliances required in connection with or incidental to the construction of the above named project in strict conformance with the following specification and drawings:

Instructions to Bidders, General Conditions, Supplemental General Conditions, Specification Divisions as shown, and all applicable addenda and Drawings as listed on the drawing cover sheets as prepared by NJRA Architects.

I/We certify, by signing this BID FORM, that I/We have a working relationship with the proposed subcontractors and that Bids are not solicited from; and/or the Contract Documents received were not listed in any Plan Rooms for distribution to subcontractors broadly.

BASE BID – for the **Alta View Clinic, ENT & General Surgery Clinics** for **Intermountain Healthcare: Project #** 10019927

For Work of the contract listed above and shown on the Drawings and described in the Project Manual, I/We agree to perform for the sum of:

_____Dollars ($_____)
(In the case of discrepancy, written amount shall govern)

ALTERNATES:

Alternate No. 1: Work in relation to Urology Exam room A103 as noted in the drawings.

ADD/DELETE_____ Dollars ($_____)
(In the case of discrepancy, written amount shall govern)
Required additional calendar days: _____

Alternate No. 2: Work in relation to new storefront window 'Type B' at Urology Clinic pod as noted in the drawings.

ADD/DELETE _____ Dollars ($_____)
(In the case of discrepancy, written amount shall govern)
Required additional calendar days: _____

CONTRACTOR'S PROPOSED CONSTRUCTION TIME PERIOD:

This Bid requires a construction time in **calendar days** from the date of authorization of_____ calendar days. The anticipated date of Substantial Completion is thus _____, 20___.

The above Bid includes _____ winter weather delay days.

ALLOWANCES:

The noted allowances are included in the returning Bid and will be tracked as individual items whereas the Owner has the discretion of use of the funds.

ADDENDA:

I/We acknowledge receipt of the following addenda for the above noted project: ___/___/___/___/___

SCHEDULE OF VALUES:

I/We have attached with this Bid Form our Schedule of Values (Section 00 4373) which reflects the above Base Bid. We submit this for Owner review of subcontractors that are being proposed for this Project.

TYPE OF ORGANIZATION:

(Corporation, Partnership, Individual, etc.) _____

SEAL (If a corporation)

Respectfully Submitted,

_____
Name of Bidder

_____

_____
Authorized Signature

GENERAL CONDITIONS

1. General Provisions
2. Intermountain
3. A/E
4. Contractor
5. Subcontractors
6. Protection of Persons and Property
7. Modifications, Request for Information, Proposed Change Orders, and Claims Process
8. Payments and Completion
9. Tests and Inspections, Substantial and Final Completion, Uncovering, Correction of Work, and Guaranty Period
10. Insurance and Bonds
11. Miscellaneous Provisions
12. Termination or Suspension of the Contract

1. GENERAL PROVISIONS.

1.1 Basic Definitions.

"Adverse Weather": Weather conditions that are seasonably abnormal and could not reasonably have been anticipated.

"**A/E**": Generally, the licensed architect (or architecture firm) or engineer (or engineering firm) for the Project. For Contracts where the design professional is an interior designer, landscape subconsultant or other design professional, "A/E" will be deemed to refer to that design professional. If the type of design professional is not subject to professional licensure requirements, the professional must meet the prevailing standards in the State in which the Project is located for the applicable practice. When Intermountain elects not to engage an A/E for a Project, Intermountain will be considered the A/E for the Project.

"**A/E's Agreement**": Unless the context requires otherwise, the agreement executed by A/E and Intermountain for the Project.

"**Addenda**": Written or graphic instruments issued before the opening of Bids, which clarify, correct or change the bidding documents or the Contract Documents.

"**ASI**": A Supplemental Instruction issued by A/E to Contractor, which may result in clarifications or minor changes in the Work, but which does not affect the Contract Time or the Contract Sum.

"**Bid**": The offer of the bidder submitted on the prescribed form setting forth the proposed stipulated sum for the Work to be performed.

"**Bonds**": The bid bond, payment and performance bonds, and other instruments of security.

"**Change Order**": A written instrument signed by Intermountain and Contractor, stating their agreement for changes to the Contract as specified on the required Intermountain change order form.

"**Claim**": A dispute, demand, assertion or other matter arising in connection with the Contract or the Project submitted by Contractor or a Subcontractor at any tier in accordance with these General Conditions. A requested amendment, requested Change Order, or a Construction Change Directive (CCD) is not a Claim unless agreement cannot be reached in accordance with the procedures in these General Conditions.

"**Construction Change Directive**" or "**CCD**": A written order signed by Intermountain, directing a change in the Work, and stating a proposed basis for adjustment, if any, in the Contract Sum or Contract Time, or both. Intermountain may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions; even if it may impact the Contract Sum and Contract Time.

"**Contract**": The Contract Documents form the Contract for Construction.

"**Contract Documents**": The documents identified as such in the Contractor's Agreement.

"**Contract Sum**": The amount stated in the Contractor's Agreement payable by Intermountain to Contractor for performance of the Work under the Contract Documents.

"**Contract Time**": The Contract Time means the period of time for Contractor's Substantial Completion of the Work to be established as set forth in the Contractor's Agreement.

"**Contractor**": The person or entity identified as the "Contractor" in the Contractor's Agreement.

"**Contractor's Agreement**": The "Contractor's Agreement" means the Construction Manager/General Contractor Agreement or the General Contractor Agreement for a Stipulated Sum, as applicable, executed by Contractor and Intermountain for the Project.

"Contractor's Direct Costs": Actual costs incurred by the Contractor for labor, materials, equipment, insurance, bonds, Subcontractors and on-site supervision. They do not include labor costs for project managers or other off-site administration.

"**Day**" or "**Days**": Calendar day unless otherwise specified.

"**Defective**": Work that does not conform to the Contract Documents or does not meet the requirements of any inspection, referenced standard, code, test or approval referred to in the Contract Documents or by applicable law, or has been damaged.

"**Director**": Intermountain's Executive Director of Design & Construction unless the context requires otherwise. Director may include a designee selected by the Director for a specific function.

"**Drawings**": The construction drawings identified in the Contractor's Agreement.

"**Intermountain**": IHC Health Services, Inc., operating through its Department of Facility Design and Construction. Unless the context requires otherwise, Intermountain is the "Owner" as that term is commonly referred to in the construction industry.

"**Intermountain Representative**" or "**Owner's Representative**": The person identified as such in the Contract Documents.

"**Inspection**" **(or any derivative)**: A review of the Project, including but not limited to a visual review of the Work to ascertain if the Work is in accordance with the Contract Documents, including all applicable building codes and construction standards.

"**Invitation to Bid**": Intermountain's solicitation or request to a contractor to provide a Bid.

"**Modification**": (1) Change Order, (2) Construction Change Directive, or (3) ASI.

"**Notice to Proceed**": A document prepared by Intermountain authorizing Contractor to commence Work on the Project. It is deemed issued upon delivery to Contractor or upon being sent by Intermountain to the address for Contractor's specified in the Bid or Proposal.

"**Partial Use**": Placing a portion of the Work in service for the purpose for which it is intended (or a related purpose) before reaching Substantial Completion for all the Work. Partial Use does not constitute "substantial completion."

"**Product Data**": Illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by Contractor to illustrate materials or equipment for some portion of the Work.

"**Project**": Generally identified and defined in the Contractor's Agreement and Contract Documents. It includes all of the Work to be performed under the Contract Documents.

"**Project Manual**" **(for construction)**: The volume of assembled Specifications for the Work, which may include the bidding/proposal requirements, sample forms, and General or Supplementary Conditions of the Contract.

"**Proposal**": A/E's or Contractor's response to Intermountain's Request for Proposal.

"**Proposal Request"** or "**PR**": A written request submitted to Contractor for a proposal to resolve an issue as part of the Change Order or Contract Modification process.

"**Proposed Change Order**" or "**PCO**": An informal request by Contractor to Intermountain Representative to commence the Contract Modification Process. It will not be considered a "Claim." The PCO may be related to any potential or actual delay, disruption, unforeseen condition or materials or any other matter for which Contractor intends to seek additional monies or time.

"**Record Drawings**": Record drawings, compiled by the A/E based upon redline "as-built" construction drawings and/or other information provided by Contractor, for each completed phase or portion of the Project for which a certificate of occupancy is issued, or for the final, completed Project (as applicable), in both AutoCAD (.dwg) and REVIT (.rvt) format (or other format as reasonable requested by Intermountain).

"**Request for Information**" or "**RFI**": A request by Contractor to A/E for information, direction or clarification regarding the Contract Documents, plans or specifications.

"**Request for Proposal**" or "**RFP**": Intermountain's solicitation for Contractor Proposals.

"**Sales Tax**" and/or "**Use Tax**": Unless the context requires otherwise, the sales tax or use tax collected or to be collected by any Federal or State Tax Commission as well as by any special district, local government or political subdivision.

"**Samples**": Physical examples, which illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

"**Shop Drawings**": Drawings, diagrams, schedules and other data specially prepared for the Work by Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.

"**Specifications**": The portion of the Contract Documents consisting of the written requirements for materials, equipment, construction systems, standards, installation and workmanship for the Work, and for performance of related systems and services.

"**Subcontractor**": Any person or entity that has a direct contract with Contractor, including any trade contractor or specialty contractor, and/or with any other Subcontractor at any tier to provide labor or materials for the Work.

"Subcontractor's Direct Costs": Actual costs incurred by a Subcontractor for labor, materials, equipment, insurance, bonds, lower-tier Subcontractors and supervision.

"**Substantial Completion**": Completion of the Work or designated portion thereof in accordance with the Contract Documents to a point sufficient to allow Intermountain to occupy and use the Work for its intended purposes, including without limitation all systems shall be fully functional and operate as designed, and the A/E's certification that Contractor has achieved Substantial Completion of the Work. The date of Substantial Completion is the date certified as such by the A/E in accordance with the Contract Documents.

"**Work**": All labor, materials, tools, equipment, construction and services required by the Contract Documents.

1.2 Correlation and Intent of Contract Documents.

1.2.1 The intent of the Contract Documents is to require Contractor to provide all labor, materials, equipment, construction, and services necessary for the proper execution and completion of the Work. The Contract Documents are complementary and what is required by any one will be as binding as if required by all. Contractor will perform the Work in accordance with the requirements expressly set forth in or reasonably inferable from the Contract Documents.

1.2.2 The organization of the Contract Documents is not intended to control Contractor in dividing the Work among Subcontractors or to establish the extent of the Work to be performed by any trade.

1.2.3 Words used in the Contract Documents that have well known technical or trade meanings are used therein in accordance with such recognized meanings.

1.2.4 In the interest of brevity, the Contract Documents may omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

1.3 Ownership and Use of Contract Documents. The Drawings, the Project Manual, and copies thereof are the property of Intermountain. Contractor will not use these documents on any other project. Contractor may retain one copy of the Drawings and the Project Manual as a contract record set and will return or destroy all remaining copies following final completion of the Work.

1.4 Public Statements Regarding Project. Contractor will not make any statements or provide any information to the media about the Project without the prior written consent of Intermountain. If Contractor receives any requests for information from media, Contractor will refer such requests to Intermountain.

1.5 Ownership and Use of Renderings and Photographs. Renderings representing the Work are the property of Intermountain. All photographs of the Work, whether taken during performance of the Work or at completion, are the property of Intermountain. Intermountain reserves all rights including copyrights to renderings and photographs of the Work. No renderings or photographs will be used or distributed without written consent of Intermountain.

1.6 Confidentiality / Property Rights.

1.6.1 All Drawings, Specifications and other documents prepared by A/E are and will remain the property of Intermountain, and Intermountain will retain all common law, statutory and other reserved rights with respect thereto. These documents were prepared and are intended for use as an integrated set for the Project which is the subject of the Contractor's Agreement and constitute works made for hire. Contractor will not modify or use Contract Documents on any other project without the prior written consent of Intermountain. Intermountain may withhold its consent in its absolute discretion. Any non-permissive use or modification, by Contractor, Contractor's Subcontractors at any tier or anyone for whose acts Contractor is liable, will be at Contractor's sole risk. Contractor will hold harmless and indemnify Intermountain from and against any and all claims, actions, suits, costs, damages, loss, expenses and attorney fees arising out of such non-permissive use or modification by Contractor. Contractor and Subcontractors are granted a limited license to use and reproduce applicable portions of the Drawings, Specifications and other documents prepared by A/E or Intermountain appropriate to and for use in the execution of their Work under the Contract Documents. All copies made under this license will bear the statutory copyright notice, if any, shown on the Drawings, Specifications and other documents prepared by A/E or Intermountain. Submittals or distributions necessary to meet official regulatory requirements or for other purposes relating to completion of the Project are not to be construed as a publication in derogation of Intermountain's copyright or other reserved rights.

1.6.2 In addition, Contractor will ensure that Contractor, Subcontractors, and the employees, agents and representatives of Contractor and its Subcontractors maintain in strict confidence, and will use and disclose only as authorized by Intermountain all Confidential Information of Intermountain that Contractor receives in connection with the performance of the Contract. Notwithstanding the foregoing, Contractor may use and disclose any information to the extent required by an order of any court or authority having jurisdiction, but only after it has notified Intermountain and Intermountain has had an opportunity to obtain reasonable protection for such information in connection with such disclosure. For purposes of the Contract, "Confidential Information" means:

1.6.3 The name or address of any affiliate, customer or contractor of Intermountain or any information concerning the transactions of any such person with Intermountain;

1.6.4 Any information relating to contracts, agreements, business plans, budgets or other financial information of Intermountain to the extent such information has not been made available to the public by Intermountain; and

1.6.5 Any other information that is marked or noted as confidential by Intermountain at the time of its disclosure.

1.7 Comply with Intellectual Property Rights of Others. Contractor represents and warrants that no Work (with its means, methods, goods, and services attendant thereto), provided to Intermountain will infringe or violate any right of any third party and that Intermountain may use and exploit such Work, means, methods, goods, and services without liability or obligation to any person or entity (specifically and without limitation, such Work, means, methods, goods, and services will not violate rights under any patent, copyright, trademark, or other intellectual property right or application for the same).

2. INTERMOUNTAIN.

2.1 Information and Services Required of Intermountain.

2.1.1 Intermountain Representative. Intermountain will designate an Intermountain Representative authorized to act in Intermountain's behalf with respect to the Project. Intermountain or such authorized representative will furnish to Contractor information or services Intermountain is required to furnish under the Contract Documents within a reasonable time in order to avoid a delay in the orderly and sequential progress of the Work.

2.1.2 Specialists and Inspectors. Intermountain reserves the right (but without obligation to provide building inspection services. This may include 'routine' and 'special' inspections. Intermountain may assign an inspector or specialist to note deviations from, or necessary adjustments to, the Contract Documents or to report deficiencies or defects in the Work. The inspector or specialist's activities in no way relieve Contractor of the responsibilities set forth in the Contract Documents.

2.1.3 Inspections. Intermountain and its representatives will have the right to inspect any portion of the Work wherever located at any time; provided that in no event will Intermountain be deemed to have assumed any obligation or liability whatsoever as a result of any such observation.

2.1.4 Surveys and Legal Description. Intermountain will furnish surveys describing the property lines and benchmarks for grading. Contractor will review this information, including the surveys and any provided geotechnical studies, and compare such information with observable physical conditions and the Contract Documents.

2.1.5 Prompt Information and Services. Upon receipt of a written request from Contractor, Intermountain will furnish information or services under Intermountain's control with reasonable promptness to avoid delay in the orderly progress of the Work.

2.1.6 Copies of Drawings and Project Manuals (for Construction). Unless otherwise provided in the Contract Documents, Contractor will be furnished electronic copies of Drawings and Project Manuals for Contractor's use in connection with the execution of the Work for the Project. Contractor will be responsible for making any further needed copies of the Construction Documents, subject to the copyright requirements.

2.2 Construction by Intermountain or By Separate Contractors.

2.2.1 Intermountain's Right to Perform Construction and to Award Separate Contracts.

a. *In General*. Intermountain reserves the right to perform construction or operations related to the Project with Intermountain's own forces, and to award separate contracts related to the Project or other construction or operations on the site.

b. *Coordination and Revisions*. Intermountain will provide for coordination of the activities of Intermountain's own forces and of each separate contractor with the Work of Contractor, who will cooperate with them. Contractor will promptly notify in writing if any such independent

action will in any way compromise Contractor's ability to meet Contractor's responsibilities under the Contract. Contractor will participate with other separate contractors and Intermountain in reviewing their construction schedules when directed to do so. Contractor will make any revisions to the construction schedule and Contract Sum deemed necessary after a joint review and agreement by Intermountain. The construction schedules will then constitute the schedules to be used by Contractor, separate contractors and Intermountain until subsequently revised.

2.2.2 Mutual Responsibility.

a. *Contractor Coordination*. Contractor will afford Intermountain and separate contractor(s) a reasonable opportunity for delivery and storage of their materials and equipment and performance of their activities and will connect and coordinate Contractor's construction and operations with theirs where applicable.

b. *Reporting Problems to Intermountain*. If part of Contractor's Work depends on work by Intermountain or a separate contractor, Contractor will, before proceeding with that portion of the Work, inspect and promptly report in writing to Intermountain apparent discrepancies or defects in workmanship that would render it unsuitable for proper execution, performance, or results. Failure of Contractor to so inspect and make this report will constitute an acceptance and acknowledgment that Intermountain's or separate contractors completed or partially completed construction is fit and proper to receive Contractor's Work, except as to defects in workmanship not then reasonably discoverable.

c. *Costs*. Costs caused by delays or by improperly timed activities or Defective construction will be borne by the responsible party in accordance with the procedures and provisions of the Contract Documents.

d. *Contractor Remedial Work*. Contractor will promptly remedy damage caused by Contractor or any Subcontractor to completed or partially completed work of Intermountain or of separate contractors or to the property of Intermountain or separate contractors and subcontractors.

e. *Intermountain's Right to Clean Up*. If a dispute arises among Contractor and separate contractors as to the responsibility under their separate contracts for maintaining the Project free from waste materials and rubbish, Intermountain may clean the Project, allocate the cost among those responsible as Intermountain and A/E determine to be just, and withhold such cost from any amounts due or to become due to Contractor.

3. A/E.

3.1 A/E's Administration of the Contract.

3.1.1 In General. A/E assists Intermountain with the administration of the Contract as described in the Contract Documents.

3.1.2 Site Visits. Site visits or inspections by A/E, Intermountain or any Intermountain representative will in no way limit or affect Contractor's responsibility to comply with all the requirements and the overall design concept of the Contract Documents as well as all applicable laws, statutes, ordinances, resolutions, codes, rules, regulations, orders and decrees. A/E will promptly submit to Intermountain a written report subsequent to each site visit.

3.1.3 Communications Facilitating Contract Administration. Except as authorized by Intermountain or as otherwise provided in the Contract Documents, including these General Conditions, A/E and Contractor will communicate through the Intermountain Representative on issues regarding the timing of the Work, cost of the Work, and scope of the Work. Contractor will comply with communication policies agreed upon at any pre-construction meeting with Intermountain. Communications by and with A/E sub-consultants will be through A/E. Communications by and with

Subcontractors will be through Contractor. Communications by and with separate contractors will be through Intermountain.

3.1.4 A/E May Reject Work, Order Inspection, Tests. A/E will have the authority to reject Work which, based upon A/E's knowledge or what may be reasonably inferred from A/E's site observations and review of data, does not conform to the Contract Documents or is damaged or rendered unsuitable. Whenever A/E considers it necessary or advisable for implementation of the intent of the Contract Documents, A/E will have the authority to require additional inspections or testing of the Work in accordance with the provisions of the Contract Documents, whether or not such Work is fabricated, installed or completed. However, neither this authority of A/E nor a decision made in good faith either to exercise or not to exercise such authority will give rise to a duty or responsibility of A/E to Contractor, Subcontractors, their agents or employees or other persons performing portions of the Work, including separate contractors.

3.1.5 A/E Review Contractor's Submittals.

a. Contractor will submit shop drawings, product data, and samples and other submittals required by the Contract Documents to A/E as required by the approved submittal schedule.

b. A/E will review and approve or take other appropriate action upon Contractor's submittals such as Shop Drawings, Product Data and Samples, but only for the purpose of checking for conformance with the information and design concepts expressed in the Contract Documents. A/E action taken on a submittal will not constitute a Modification of the Contract.

c. A/E's action will be taken no later than fifteen (15) Days following A/E's receipt of the submittal, unless agreed to otherwise by Contractor and Intermountain.

d. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of Contractor as required by the Contract Documents.

e. A/E's review of Contractor's submittals will not relieve Contractor of the obligations under the Contract Documents.

f. A/E's review will not constitute approval of safety precautions or, unless otherwise specifically stated by A/E, of any construction means, methods, techniques, sequences or procedures.

g. A/E's approval of a specific item will not indicate approval of an assembly of which the item is a component.

h. When professional certification of performance characteristics of materials, systems or equipment is required by the Contract Documents, A/E will be entitled to rely upon such certifications to establish that the materials systems or equipment will meet the performance criteria required by the Contract Documents.

3.2 Ownership and Use of A/E's Drawings, Specifications and Other Documents. All Drawings, Specifications and other documents prepared by A/E are and will remain the property of Intermountain, and Intermountain will retain all common law, statutory and other reserved rights with respect thereto. These documents were prepared and are intended for use as an integrated set for the Project which is the subject of the Contractor's Agreement and constitute works made for hire. Contractor will not modify or use Contract Documents on any other project without the prior written consent of Intermountain. Intermountain may withhold its consent in its absolute discretion. Any non-permissive use or modification, by Contractor, Contractor's Subcontractors at any tier or anyone for whose acts Contractor is liable, will be at Contractor's sole risk. Contractor will hold harmless and indemnify Intermountain from and against any and all claims, actions, suits, costs, damages, loss, expenses and attorney fees arising out of such non-permissive use or modification by Contractor. Contractor and Subcontractors are granted a limited license to use and reproduce applicable portions of the Drawings, Specifications and other documents prepared by

A/E or Intermountain appropriate to and for use in the execution of their Work under the Contract Documents. All copies made under this license will bear the statutory copyright notice, if any, shown on the Drawings, Specifications and other documents prepared by A/E or Intermountain. Submittals or distributions necessary to meet official regulatory requirements or for other purposes relating to completion of the Project are not to be construed as a publication in derogation of Intermountain's copyright or other reserved rights.

4. CONTRACTOR. Contractor's duties include the professional services of a business, administrative and management consultant to Intermountain; including all budget, scheduling, quality, safety and all other services related to assuring compliance with the Contract Documents.

4.1 Review of Contract Documents and Field Conditions by Contractor. By executing the Contractor's Agreement, Contractor represents that it has visited the Project site, familiarized itself with the local conditions under which the Work is to be performed, and correlated its own observations with the requirements of the Contract Documents.

4.1.1 Reviewing Contract Documents, Information, Reporting Errors, Inconsistencies or Omissions.

a. Contractor will carefully study and compare the Contract Documents with each other and with information available relating to the Project or furnished by Intermountain before commencing and during performance of each portion of the Work and will at once report to Intermountain and A/E any errors, inconsistencies or omissions it discovers. If Contractor performs any construction activity without such notice to Intermountain and A/E and before the resolution of the error, inconsistency or omission, Contractor will assume responsibility for such performance and will bear the attributable costs for correction.

b. Contractor will give Intermountain and/or A/E notice of any additional drawings, specifications, or instructions required to define the Work in greater detail, or to permit the proper progress of the Work, sufficiently in advance of the need for information so as not to delay the Work.

c. It is not Contractor's responsibility to ascertain that the Contract Documents are in accordance with requirements of applicable laws, statutes, ordinances, building codes, rules and regulations. However, if Contractor observes that portions of the Contract Documents are at variance with those requirements, Contractor will immediately notify Intermountain and/or A/E in writing. Contractor will not proceed unless Intermountain and/or A/E effects Modifications to the Contract Documents required for compliance with such requirements. Contractor will be fully responsible for any work knowingly performed contrary to such requirements and will fully indemnify Intermountain against loss and bear all costs and penalties arising therefrom.

4.1.2 Field Conditions.

a. Contractor will take field measurements and verify field conditions and will carefully compare such field measurements and conditions and other information known to Contractor, or information which a Contractor of ordinary skill and expertise for the type of Work involved would have known, before commencing activities. Errors, inconsistencies or omissions discovered will be reported to Intermountain and A/E at once. If Contractor performs any construction activity without such notice to Intermountain and A/E and before the resolution of the error, inconsistency or omission, Contractor will not be entitled to any compensation for additional costs attributable to correction or otherwise to Contractor resulting from field measurements or conditions different from those anticipated by Contractor which would have been avoided had Contractor taken field measurements and verified field conditions before ordering the materials or commencing construction activities.

b. If site conditions indicated in the Contract Documents or other information provided by Intermountain or A/E to Contractor differ materially from those Contractor encounters in performance of the Work, Contractor will immediately notify Intermountain and/or A/E in writing of such differing site conditions.

4.1.3 Perform in Accordance with Contract Documents and Submittals. Contractor will perform the Work in accordance with the Contract Documents and submittals approved in accordance with the Contract Documents. Should Contractor or any of its Subcontractors become aware of any question regarding the meaning or intent of any part of the Contract Documents before commencing that portion of the Work about which there is a question, Contractor will request an interpretation or clarification from Intermountain and/or A/E before proceeding. Contractor proceeds at its own risk if it proceeds with the Work without first making such a request and receiving an interpretation or clarification from Intermountain and/or A/E.

4.1.4 Performance to Produce the Complete System and Intended Results. Performance by Contractor will be required to the extent consistent with the Contract Documents and reasonably inferable from the Contract Documents as being necessary to allow the system to function within its intended use.

4.1.5 Intent and Hierarchy. The Contract Documents should be read as a whole and wherever possible, the provisions should be construed in order that all provisions are operable. The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by Contractor. The Contract Documents are complimentary, and what is required by one Document or provisions thereof will be as binding as if required by all the Documents or provisions thereof. In case of an irreconcilable conflict between provisions within a Contract Document or between Contract Documents, the following priorities will govern as listed below:

a. A particular Modification will govern over all Contract Document provisions or Modifications issued before this particular Modification.

b. A particular Addendum will govern over all other Contract Document provisions issued before this particular Addendum. Subsequent Addenda will govern over all prior Addenda.

c. The Supplementary Conditions will govern over the General Conditions.

d. The Agreement and these General Conditions will govern over all other Contract Documents except for the Supplementary Conditions, Addenda, Modifications.

e. The drawings and specifications will not govern over any of the documents listed above. The specifications take precedence over the drawings.

f. Within the Drawings, larger scale drawings take precedence over smaller scale drawings, figured dimensions over scaled dimensions, and noted materials over graphic indications.

g. In case of a conflict or ambiguity within the same level of hierarchy of described documents, Intermountain reserves the right to select the most stringent requirement unless the preponderance of the contract indicates the less stringent requirement.

4.1.6 Dividing Work and Contractor Representation. Organization of the specifications into divisions, sections and articles, and arrangement of Drawings, will not control Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade. Contractor represents that the Subcontractors, Sub-subcontractors, manufacturers and suppliers engaged or to be engaged by it are and will be familiar with the requirements for performance by them of their obligations. Where the Contract Documents require Contractor to provide professional services for architecture or engineering, Contractor will cause such services to be performed by appropriately licensed professionals.

4.1.7 Planning and Priority. Contractor will plan and schedule its work to facilitate the Project and will maintain a work schedule to place proper priority to sequence work to complete the project timely.

4.1.8 Prior to Contractor taking control over any area in any existing facility or on any project site, Contractor will provide prior written notice to Intermountain with sufficient time (no less than 30 Days) to allow Intermountain's Asset Recovery Team to remove, secure, and otherwise address existing materials, furniture, fixtures, equipment, and other assets located thereon.

4.2 Supervision and Construction Procedures.

4.2.1 Supervision and Control.

a. Contractor will utilize its best skill, efforts, and judgment to provide efficient business administration and supervision, to furnish at all times an adequate supply of workers and materials, and to perform the Work in an expeditious and economical manner consistent with the interests of Intermountain.

b. Contractor will supervise and direct the Work. Contractor will be solely responsible for all construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work.

c. All loss, damage, liability, or cost of correcting Defective work arising from the use of any construction means, methods, techniques, sequences or procedures will be borne by Contractor, notwithstanding that such construction means, methods, techniques, sequences or procedures are referred to, indicated or implied by the Contract Documents, unless Contractor has given timely notice to Intermountain and A/E in writing that such means, methods, techniques, sequences or procedures are not safe or suitable, and Intermountain has then instructed Contractor in writing to proceed at Intermountain's risk.

4.2.2 Responsibility. Contractor will be responsible to Intermountain for acts and omissions of Contractor's employees, Subcontractors, and their agents and employees, and other persons performing portions of the Work under a contract with Contractor or on behalf of Contractor.

4.2.3 Not Relieved of Obligations. Contractor will not be relieved of obligations to perform the Work in accordance with the Contract Documents either by activities or duties of Intermountain or its agents in Intermountain's administration of the Contract, or by tests, inspections or approvals by Intermountain, A/E, or their consultants, or as required or performed by persons other than Contractor or for those that Contractor is liable.

4.2.4 Inspections and Approvals.

a. Contractor is responsible for requesting inspections for various stages and portions of the Work required under the Contract Documents in a timely manner.

b. Contractor will be responsible for inspection of portions of the Work already completed to determine that such portions are in proper condition to receive subsequent portions of the Work.

c. If any of the Work is required to be inspected or approved by the terms of the Contract Documents by any public authority, Contractor will timely request such inspection or approval to be performed in accordance with Article 9. Except as provided in Article 9, work will not proceed without any required inspection and the associated authorization to proceed. Contractor will promptly notify Intermountain if the inspector fails to appear at the site.

4.3 Labor and Materials.

4.3.1 Payment by Contractor. Except to the extent it is otherwise stated in the Contract Documents, Contractor will provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities, supplies, consumables and services necessary for the proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

4.3.2 Discipline and Competence. Contractor will enforce strict discipline and good order among Contractor's employees, Subcontractors, agents, representatives and other persons performing under the Contract Documents. Contractor will not permit employment of unfit persons or persons not skilled in tasks assigned to them.

4.3.3 Phased Construction / Accommodations for Facilities to Stay Operational. Contractor and all Subcontractors will direct and perform the Work, phase and coordinate all construction and related

activities and timing, in a manner to preserve ongoing patient care and safety to all and to accommodate in every instance Intermountain's ongoing business operations such that facilities stay fully functioning, operational, and in compliance with applicable laws and regulations at all times.

4.4 Taxes and Other Payments to Government. Intermountain will pay all taxes and assessments on the real property comprising the Project site. Contractor will pay all applicable sales, consumer, use, payroll, workers compensation, unemployment, old age pension, surtax, and employment-related and similar taxes related to performance of the Work or portions thereof provided by Contractor which are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect, and will comply with the laws and regulations regarding the payment of Sales and/or Use Tax and any applicable exemptions.

4.5 Permits, Fees, Notices, Labor and Materials.

4.5.1 Permits and Fees.

a. Intermountain will obtain and pay for all zoning and use permits and permanent easements necessary for completion of the Work.

b. Contractor will obtain and pay for the building permit, and all other permits, governmental fees, licenses and inspections necessary for the proper execution and completion of the Work.

c. Contractor will secure any certificates of inspection and of occupancy required by authorities having jurisdiction over the Work. Contractor will deliver these certificates to A/E before issuance of the Certificate of Substantial Completion by A/E.

4.5.2 Compliance with Law, Public Authorities, Notices. Contractor will comply with all applicable federal, state and local laws, statutes, ordinances, resolutions, rules, regulations, codes, and lawful orders of public authorities.

4.5.3 Correlation of Contract Documents and Enactments.

a. It is not Contractor's responsibility to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, resolutions, building codes, and rules and regulations. Notwithstanding this, if Contractor observes, or if such is readily observable to a Contractor of ordinary skill and expertise for the type of Work involved, that a portion of the Contract Documents is at variance therewith, Contractor will promptly notify A/E and Intermountain in writing, and necessary changes will be accomplished by appropriate Modification.

b. Contractor will coordinate and supervise the work performed by Subcontractors so that the Work is carried out without conflict between trades and so that no trade, at any time, causes delay to the general progress of the Work. Contractor and all Subcontractors will at all times afford each trade, any separate contractor, or Intermountain, reasonable opportunity for the installation of Work and the storage of materials.

c. Contractor is fully responsible for the Project and all materials and work connected therewith until Intermountain has accepted the Work in writing. Contractor will replace or repair at its own expense any materials or work damaged or stolen, regardless of whether it has received payment for such work or materials from Intermountain.

d. Contractor will remedy all damage or loss to any property caused in whole or in part by Contractor, any Subcontractor, or by anyone for whose acts any of them may be liable.

e. Intermountain may elect to purchase materials required for the Work. In that event, Contractor will comply with the procedures set forth in the Contract Documents relating to such materials.

4.5.4 Failure to Give Notice. If Contractor, or any Subcontractor thereof performs Work without complying with the requirements of this Article 4.5 hereinabove, Contractor will assume appropriate responsibility for such Work and will bear the appropriate amount of the attributable costs.

4.5.5 Intermountain-Purchased Materials and Equipment.

a. In addition to Contractor's other obligations with respect to separate Intermountain provided work or materials, Contractor's obligations and duties with respect to Intermountain-purchased materials, equipment, and work include:

(i) Scheduling: The Contractor shall furnish Intermountain with a schedule of dates on which the Contractor requires delivery of Intermountain-purchased materials. Intermountain will arrange for the materials to be delivered to the construction site or picked up by Contractor on or before the specified dates. If delivery or pick up dates are changed, rescheduled, or otherwise varied from the original schedule, the Contractor shall notify Intermountain in writing of delivery or pick up date rescheduling and the Contractor shall coordinate the delivery or pick up of the Intermountain-purchased materials or equipment directly with the supplier.

(ii) Equipment / Vehicles: If Intermountain buys equipment or vehicles for Contractor's use on the Project, Contractor will (in addition to all other obligations herein relative to such equipment or vehicles) be fully and solely responsible for such equipment and vehicles as well as the use and use consequences thereof for any and all purposes (including without limitation to protect, secure, inspect, upkeep and make repairs, and insure such equipment and vehicles as well as to monitor, guide, direct, oversee, protect, and control the use and use consequences of such equipment and vehicles) until completion of the Project and Contractor's return of such equipment and/or vehicles to Intermountain.

(iii) Pre-Installation Inspection: The Contractor shall be responsible for receiving, inspecting and storing all Intermountain- purchased materials and equipment until the materials or equipment are needed for installation or use by the Contractor. Regardless of any inspection performed by Intermountain of the Intermountain-purchased materials or equipment, the Contractor shall be responsible for inspecting the Intermountain-purchased materials and equipment to determine suitability, quality and conformance with specifications before installation or use or at such other times as the Contractor may desire in order to avoid interruptions and delays in the progress of the Project. The Contractor shall reject any material which does not meet specifications or which appears to have any defect which may make the material unsuitable for use in the Project. The Contractor shall notify Intermountain and the manufacturer or supplier of all defects and assist Intermountain in arranging for the repair, replacement or correction of the defective condition. The Contractor shall not be entitled to an extension of any deadline or completion date which results from failure to discover defects which the Contractor should have discovered through an inspection.

(iv) Defective Materials: The Contractor acknowledges that use of improper or defective material may result in costs and damages to Intermountain in excess of the value of the materials; that after use in the Project it may be difficult or impossible to inspect the material to determine the cause of any failure; and that in the event of the failure of material there may be a question as to the cause of the failure. Because the Contractor's employees will be the last to handle and inspect material prior to incorporation into the Project, the Contractor will be liable to Intermountain for damages resulting from failure of Intermountain- purchased materials during the Contractor's warranty period specified herein from any cause whatsoever unless the Contractor provides clear and convincing proof that (1) the entire loss from a failure is covered by a valid manufacturer's or supplier's warranty, or (2) the Contractor could not have prevented the failure by complying with the requirements of this Section concerning Intermountain-purchased materials.

(v) Claims: The Contractor agrees to assist Intermountain to present claims to manufacturers and suppliers for defects in Intermountain-purchased materials. Where there is any question as to the division of liability between the Contractor and a manufacturer or vendor, the

Contractor shall provide all relevant information in the Contractor's possession which may aid Intermountain in determining the division of responsibility. Intermountain shall have final approval of any proposed adjustment or settlement of warranty claims.

(vi) Implied Warranties: The benefit of contractual and implied warranties with respect to Intermountain-purchased materials and equipment shall run to Intermountain and not to the Contractor.

(vii) Unloading: Except as otherwise provided herein, the Contractor shall be responsible for unloading all Intermountain- purchased materials and equipment and for verifying delivery amounts to Intermountain.

(viii) Custody and Security: The Contractor shall secure and protect Intermountain-purchased materials and equipment from loss, deterioration, damage, theft, vandalism or destruction. If any Intermountain-purchased materials or equipment are damaged, stolen, or lost, Contractor will timely replace such at Contractor's sole cost and expense. In such event, Contractor will not be entitled to any modification in Contract Time or Contract Sum.

(ix) Reports: At Intermountain's request, the Contractor shall furnish reports to the Intermountain Representative demonstrating the Contractor's compliance with this Section.

(x) Retained Ownership: All materials and equipment purchased by Intermountain which remain after completion of the Project shall be the property of Intermountain. If Intermountain does not wish to retain or dispose of surplus Intermountain-purchased materials or equipment, the Contractor shall remove and dispose of them.

b. None of the foregoing duties of the Contractor with respect to Intermountain-purchased materials shall prevent Intermountain from exercising any prerogative of ownership of the materials or equipment.

4.6 Superintendent. Contractor will employ a competent superintendent and necessary assistants who will be in attendance at the Project site at all times during performance of the Work. The superintendent will represent Contractor, and communications given to the superintendent will be as binding as if given to Contractor. Important communications will be confirmed in writing. Other communications will be similarly confirmed on written request in each case.

4.7 Time and Contractor's Construction Schedules.

4.7.1 Progress and Completion.

a. *Time Is of The Essence; Complete Within Contract Time*. Time is of the essence. By executing the Contractor's Agreement, Contractor confirms that the Contract Time is adequate to perform the Work. Contractor will proceed expeditiously with adequate forces to achieve Substantial Completion within the Contract Time.

b. *Notice to Proceed and Insurance*. Contractor will not prematurely commence operations on the site or elsewhere before the issuance of a Notice to Proceed by Intermountain and in no event before the effective date of insurance required by Article 10 to be furnished by Contractor. In addition and without limitation of the foregoing, Contractor will not proceed with further Work or services after performing preconstruction services until Contractor receives a subsequent Notice to Proceed.

4.7.2 Schedule Preparation. Contractor, promptly after being awarded the Contract, will prepare and submit for Intermountain's and A/E's review a reasonably detailed CPM schedule for the Work. The schedule will indicate the order, sequence, and interdependence of all items known to be necessary to complete the Work including construction, procurement, fabrication, and delivery of materials and equipment, submittals and approvals of samples, shop drawings, procedures, or other documents.

Work items of Intermountain, other Contractors, utilities and other third parties that may affect or be affected by Contractor will be included. If Intermountain is required, by the Contract Documents, to furnish any materials, equipment, or the like, to be incorporated into the Work by Contractor, Contractor will submit, with the first schedule submittal, a letter clearly indicating the dates that such items are required at the Project site. The critical path should be identified, including the critical paths for interim completion dates and milestones. The CPM schedule will be developed using Primavera, MS Project, or Suretrack unless otherwise authorized by Intermountain Representative. Contractor's schedule will be updated at least once per month and submitted with each pay request. Contractor will maintain an original baseline schedule and will provide Intermountain monthly written reports indicating Contractor's compliance or noncompliance with the original schedule.

4.7.3 Initial Contract Time. Unless otherwise specified in the bidding documents, the initial Contract Time is the time identified in the Contractor's Agreement.

4.7.4 Interim Completion Dates and Milestones. The schedule must include contractually specified interim completion dates and milestones. The milestone completion dates indicated are considered essential to the satisfactory performance of this Contract and to the coordination of all Work on the Project. The milestone dates listed are not intended to be a complete listing of all Work under this Contract or of interfaces with other Project contractors.

4.7.5 Schedule Content Requirements. The schedule will indicate an early completion date for the Project that is no later than the Project's required completion date. The schedule, including all activity duration's will be given in calendar days. The Schedule will also indicate all of the following:

a. Interfaces with the work of outside contractors (e.g., utilities, power and with any separate Contractor);

b. Description of activity including activity number/numbers;

c. Estimated duration time for each activity;

d. Early start, late start, early finish, late finish date, and predecessor/successors including stop-start relationships with lead and lag time for each activity;

e. Float time available to each path of activities;

f. Actual start date for each activity begun;

g. Actual finish date for each activity completed;

h. The percentage complete of each activity in progress or completed;

i. Identification of all critical path activities;

j. The critical path for the Project, with this path of activities being clearly and easily recognizable on the time-scaled network diagram. The path(s) with the least amount of float time must be identified. Unless otherwise authorized by Intermountain Representative, no more than 40% of all activities may be identified as critical path items. The relationship between non-critical activities and activities on the critical path will be clearly shown on the network diagram;

k. Unless otherwise authorized by Intermountain Representative, all activities on the schedule representing construction on the site may not have duration longer than fourteen (14) Days. Construction items that require more than fourteen (14) Days to complete must be broken into identifiable activities on the schedule with durations less than fourteen (14) Days. The sum of these activities represents the total length required to complete that construction item; and

l. Additional requirements as specified in the Supplemental General Conditions.

4.7.6 Intermountain's Right to Take Exceptions. Intermountain reserves the right to take reasonable exception to activity duration, activity placement, construction logic or time frame for any element of the Work to be scheduled.

4.7.7 Float Time. Float time is defined as the amount of time between the earliest start date and the latest start date or between the earliest finish date and the latest finish date of a chain of activities on the Schedule. By a proposal request or modification delivered to Contractor, Intermountain has the right to use the float time for non-critical path activities until Contractor has reallocated such time on a newly submitted schedule.

4.7.8 Initial Schedule Submission. No progress payments will be approved until Contractor has submitted a Project detailed CPM schedule for the entire project.

4.7.9 Updates. Before any approval of a pay request, Intermountain, A/E and Contractor will review Contractor's schedule compared to the Work completed. Intermountain approves the amount of Work completed as supported by the schedule of values and as verified by the determination of Work completed. If necessary, Contractor will then update and submit to Intermountain the schedule with the pay request; all of which in accordance with Intermountain's approval. All updates will be provided in electronic and hard copy formats. At each scheduled meeting with Intermountain Representative, Contractor will provide at minimum a "three week look ahead" with long lead items identified.

4.7.10 Schedule of Submittals. Contractor will prepare and keep current, for A/E's and Intermountain's review, a schedule of submittals required under the Contract Documents which is coordinated with Contractor's construction schedule and allows A/E a reasonable time to review the submittals. This submittal schedule is to be included as part of the construction schedule. Submittals requiring expedited review must be clearly identified as such in the schedule of submittals.

4.7.11 Schedule Recovery. If the Work represented by the critical path falls behind by more than seven (7) Days, the project schedule will be redone within fourteen (14) Days showing how Contractor will recover the time. A narrative that addresses the changes in the schedule from the previously submitted schedule will be submitted along with the schedule in both hard copy (appropriate report formats to be determined by Intermountain Representative) and electronic copy. Contractor will comply with the most recent schedules.

4.7.12 Schedule Changes and Modifications.

a. *Contract Time Change Requires Modification*. The Contract Time may only be shortened or extended by a Modification fully executed by Intermountain.

b. *Contractor Changing Activity Durations*. Should Contractor, after approval of the complete detailed construction schedule, desire to change his plan of construction, he will submit his requested revisions to Intermountain and A/E along with a written statement of the revisions including a description of the sequence and duration changes for rescheduling the work, methods of maintaining adherence to intermediate milestones and the contract completion date and the reasons for the revisions. If the requested changes are acceptable to Intermountain, which acceptance will not be unreasonably withheld, they will be incorporated into the Schedule in the next reporting period. If after submitting a request for change in the Contract Schedule, Intermountain does not agree with the request, Intermountain will schedule a meeting with Contractor to discuss the differences.

c. *Changes in Contract Time*. The critical path schedule as the term is used in the provisions herein will be based on the current version of Contractor's schedule for the Project and accepted by Intermountain just before the commencement of the modification, asserted delay, suspension or interruption. If Contractor believes it is entitled to an extension of Contract Time under the

Contract Documents, Contractor will submit a PCO in accordance with Article 7.2 to A/E and Intermountain Representative accompanied by an analysis of the requested time adjustment.

4.7.13 Extensions of Time.

a. If Substantial Completion of the Project is delayed because of any of the following causes, then the Contract Time will be extended by Modification for a period of time equal to such delay:

(i) Labor strikes or lock-outs;

(ii) Unusual delay in transportation;

(iii) Unforeseen governmental requests or requirements;

(iv) A Change in the Work resulting from an instruction by Intermountain or A/E to Contractor subject to the conditions set forth in Section 7.1.5;

(v) Unforeseen Subsurface Condition subject to the conditions set forth in Section 7.1.6; or

(vi) Any other event or circumstance caused by the willful or negligent act or omission of Intermountain or A/E subject to the conditions set forth in Section 7.1.6.

b. Contractor will not be entitled to any compensation for delay described in Section 4.7.13, Paragraph a, subparagraphs (i), (ii), and (iii).

c. In no event will any time extension or cost adjustment be given on account of delay which reasonably should have been anticipated by the Contractor or in circumstances where performance of the Work is, was, or would have been, delayed by any other cause for which the Contractor is not entitled to an extension.

d. Adverse Weather delays. Completion time will not be extended for normal bad weather or any weather that is reasonably foreseeable at the time of entering into the contract. The time for completion as stated in the contract documents includes due allowance for calendar days on which Work cannot be performed due to weather conditions. The Contractor acknowledges that it may lose days due to weather conditions. Notwithstanding, the Contract Time may be extended (but at no cost to Intermountain) if all of the following are established by the Contractor:

(i) That the weather prevented Work from occurring that is on the critical path for the project based upon a critical path schedule previously submitted to Intermountain and to the extent accepted by Intermountain;

(ii) There are no concurrent delays attributed to the Contractor;

(iii) The Contractor took all reasonable steps to alleviate the impact of the weather and took reasonable attempts to prevent the delay and despite such reasonable actions of Contractor, the weather impacted the critical path as described above; and

(iv) One of the following occurred:

1. The weather was catastrophic, such as a tornado, hurricane, severe wind storm, severe hail storm; or

2. Based on the full history of information published from the closest station as indicated from the Western Regional Climate Center (Desert Research Institute 2215 Raggio Parkway Reno, Nevada 89512, and as may be described on the website at http://www.wrcc.dri.edu/summary/), one or more of the following occurred:

a. For any day between November 1 and March 31, the minimum temperature fell below the average minimum temperature plus the extreme low temperature recorded for the month divided by 2.

b. For any day between November 1 and March 31, the maximum temperature fell below the monthly average for the minimum temperature.

c. The daily precipitation exceeded 75% of the historical one day maximum for the month.

d. The snowfall for the month exceeded 175% of the historical average snow fall for the month.

Contractor will not be entitled to any compensation for Adverse Weather.

4.7.14 Time Extension Request. Unless a shorter time period is set forth herein or in other Contract Documents, any time extension will be requested by Contractor within twenty-one (21) Days after Contractor knew or should have known about the delay and will be supported by the critical path schedule analysis.

4.7.15 Delay in Completion of the Work.

a. *Prior to Substantial Completion.* For each Day after the expiration of the Contract Time that Contractor has not achieved Substantial Completion, Contractor will pay Intermountain the amount set forth in the Agreement as liquidated damages for Intermountain's loss of use of the Project and the added administrative expense to Intermountain to administer the Project during the period of delay. In addition, Contractor will reimburse Intermountain for any additional Consultant's fees, attorney fees, expert fees, consultant fees, copy costs, and other expenses incurred by Intermountain as a result of the delay. The parties have agreed on this liquidated damages provision because actual damages which will result from a delay in Substantial Completion cannot readily be ascertained at the time of execution of the Agreement and the parties wish to fix such damages as a their reasonable estimate of such actual damages, and not as a penalty. Intermountain may deduct any liquidated damages or reimbursable expenses from any money due or to become due to Contractor. If the amount of liquidated damages and reimbursable expenses exceeds any amounts due to Contractor, Contractor will pay the difference to Intermountain within ten (10) Days after receipt of a written request from Intermountain for payment

b. *After Substantial Completion.* For each Day that Contractor exceeds the time allowed for completion of the remaining items set forth in the Certificate of Substantial Completion, Contractor will pay to Intermountain as liquidated damages for additional administrative expenses the amount set forth in the Agreement. In addition, Contractor will reimburse Intermountain for any additional Consultant's fees, attorney fees, expert fees, consultant fees, copy costs, and other expenses incurred by Intermountain as a result of the delay in completing such items.

c. *No Waiver of Intermountain's Rights*. Permitting Contractor to continue any part of the Work after the time fixed for completion or beyond any authorized extension thereof, will in no way operate as a waiver or estoppel on the part of Intermountain of any of its rights under the Contract Documents, including the right to liquidated damages or any other remedies or compensation.

4.8 Documents and Samples at the Site; Certifying "As-Builts". Contractor will maintain at the site for Intermountain, one record copy of the Drawings, Specifications, Addenda, Change Orders and other Modifications, in good order and marked weekly to record changes and selections made during construction, as well as approved Shop Drawings, Product Data, Samples and similar submittals. These items will be available to A/E and will be delivered to A/E for submittal to Intermountain upon completion of the Work, or upon completion of any phase of the Work as agreed to by the parties, signed by Contractor, certifying that they show complete and exact "as-built" conditions and location, stating sizes, kind of materials, vital piping, conduit locations and similar matters. All notes of encountered or changed conditions will be included.

4.9 Shop Drawings, Product Data and Samples.

4.9.1 Not Contract Documents. Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents. The submittal will demonstrate, for those portions of the Work for which the submittal is required, the way Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents.

4.9.2 Promptness. Contractor will review, approve and submit to A/E, Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents with reasonable promptness and in such sequence as to cause no delay in the Work, or the activities of Intermountain or separate contractors.

4.9.3 Not Perform Until A/E Approves. Contractor will perform no portion of the Work requiring submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been approved in writing by A/E. Such Work will be in accordance with the approved submittals.

4.9.4 Representations by Contractor. By approving and submitting Shop Drawings, Product Data, Samples and similar submittals, Contractor represents that Contractor has determined and verified materials, field measurements and field construction criteria related thereto, and has checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

4.9.5 Contractor's Liability. Contractor will not be relieved of responsibility for deviations from the requirements of the Contract Documents by A/E's approval of Shop Drawings, Product Data, Samples or similar submittals unless Contractor has specifically informed A/E in writing of such deviation at the time of the submittal and A/E has given written approval to the specific deviation. Contractor will not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by A/E's review and comment.

4.9.6 Direct Specific Attention to Revisions. Contractor will direct specific attention in writing to all revisions on resubmitted Shop Drawings, Product Data, Samples or similar submittals, except those requested by A/E and indicated on previous submittals.

4.9.7 Informational Submittals. Informational submittals upon which A/E is not expected to take responsive action may be so identified in the Contract Documents.

4.9.8 Reliance on Professional Certification. When professional certification of performance criteria of materials, systems or equipment is required by the Contract Documents, Intermountain and A/E will be entitled to rely upon the accuracy and completeness of such calculations and certifications. If a professional stamp is required, the professional will be licensed in the State in which the Project is located unless otherwise approved by Intermountain in writing. Likewise, Contractor is entitled to rely upon the accuracy and completeness of the calculations made by A/E in developing the Contract Documents, unless a Contractor of ordinary skill and expertise for the type of Work involved would know that such is inaccurate or incomplete and therefore must immediately notify Intermountain in writing.

4.10 Use of Project Site.

4.10.1 In General.

a. Intermountain may, in Intermountain's discretion, permit Contractor to occupy or otherwise use portions of the Project site or, if applicable and available, other Intermountain property within the vicinity of the Project, for general office, staging, or other purposes as more particularly provided in the Project Specifications. As used herein, the term "Project site" or "site" will be deemed to refer to any other Intermountain property used by Contractor in connection with the Project, in addition to the actual Project site. Intermountain may, in its discretion, require Contractor to enter into a separate license agreement, on Intermountain's standard form, with

respect to Contractor's occupancy or other use of Intermountain space at the actual Project site or within other Intermountain property.

b. Contractor will confine operations at the site to areas permitted by the Contract Documents, law, ordinances, resolutions, rules and regulations, and permits and will not unreasonably encumber the site with materials or equipment. Contractor will take all reasonable means to secure the site, protect the site and protect the Work from any damage. The site will be left free and clear of refuse, equipment, materials, etc. and the site will not be subject to spilled liquids and chemicals, toxic or otherwise. Should such an incident occur while Contractor has control of the site, Contractor will be responsible to clean, repair, or restore the site and pay all associated costs, fines and penalties. Contractor will indemnify and hold Intermountain harmless from and against any and all loss, cost, damage, injury or expense, including claims for death or injury to person or damage to property, and including without limitation attorney's fees and court costs, to the extent arising out of or in connection with use of the site by Contractor or its contractors, employees, or invitees. Notwithstanding the foregoing, Contractor is not responsible for any damage to the site or the Work to the extent caused by Intermountain or Intermountain's agents.

c. Contractor recognizes that the Project site and the surrounding area is frequently visited by the public and is important to Intermountain's image and function and will maintain the premises free from debris and waste materials resulting from Construction. At the completion of Construction, Contractor will promptly remove construction equipment, tools, surplus materials, waste materials and debris.

4.10.2 Access to Neighboring Properties. Contractor will not, except as provided in the Contract Documents or with Intermountain's advance written consent when necessary to perform the Work, interfere with access to properties neighboring the Project site by the owners of such properties and their respective tenants, agents, invitees and guests.

4.11 Access to Work. Contractor will provide Intermountain and A/E access to the Work in preparation and progress, wherever located.

4.12 Royalties and Patents. Contractor will pay all royalties and license fees. Contractor will defend suits or claims for infringement of patent rights and will hold Intermountain and A/E harmless from loss on account thereof, but will not be responsible for such defense or loss when a particular design, process or product of a particular manufacturer or manufacturers is required by the Contract Documents. However, if Contractor has reason to believe that the required design, process or product is an infringement of a patent, Contractor will be responsible for such loss unless such information is promptly furnished to Intermountain in writing.

4.13 Indemnification.

4.13.1 To the fullest extent permitted by law, Contractor will indemnify and hold harmless Intermountain and its affiliates, subsidiaries, officers, employees, agents, authorized volunteers (hereinafter the above listing of entities and persons is referred to as "**indemnitees**") from and against every kind and character of claims, liabilities, damages, losses, settlements, and expenses, including but not limited to attorneys' fees, consultant fees, expert fees, and other costs and expenses, and including without limitation those events covered under the blanket Contractual Liability Coverage required under the Contract Documents, arising out of or resulting from performance of the Work, including without limitation the work of all the Subcontractors and their employees, except to the extent that such liability arises out of the negligence of Intermountain, its representatives, agents, and employees. This indemnity includes, without limitation, indemnification of Intermountain from all losses or injury to Intermountain's property, except to the extent that such loss or injury arises out of the negligence of Intermountain, its representatives, agents, and employees. This indemnity applies, without

limitation, to include Claims occurring both during performance of the Work and/or subsequent to completion of the Work. In the event that any Claim is caused in part by a party indemnified hereunder, that party will bear the cost of such Claim to the extent it was the cause thereof. In the event that a claimant asserts a Claim for recovery against any party indemnified hereunder, the party indemnified hereunder may tender the defense of such Claim to Contractor. If Contractor rejects such tender of defense and it is later determined that the negligence of the party indemnified hereunder did not cause all of the Claim, Contractor will reimburse the party indemnified hereunder for all costs and expenses incurred by that party in defending against the Claim. Contractor will not be liable hereunder to indemnify any party for damages resulting from the sole negligence of that party. Notwithstanding, Intermountain will have the right, at its option, to participate in the defense of any such action without relieving Contractor of any obligation hereunder.

4.13.2 In addition to the foregoing, Contractor will be liable to defend Intermountain in any lawsuit filed by any Subcontractor relating to the Project. Where liens have been filed against Intermountain's property, Contractor (and/or its bonding company which has issued bonds for the Project) will obtain lien releases and record them in the appropriate county and/or local jurisdiction and provide Intermountain with a title free and clear from any liens of Subcontractors. In the event that Contractor and/or its bonding company are unable to obtain a lien release, Intermountain in its absolute discretion may require Contractor to provide a bond around the lien or a bond to discharge the lien, at Contractor's sole expense.

4.13.3 In addition to the foregoing, Contractor will indemnify and hold Intermountain harmless from any claim of any other contractor resulting from the performance, nonperformance or delay in performance of the Work by Contractor.

4.13.4 The indemnification obligation under this Article 4.13 will not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for Contractor or Subcontractor under workers' or workmen's compensation acts, disability benefits acts or other employee benefit acts.

4.13.5 Intermountain and Contractor waive all rights against each other for damages to the Work during construction to the extent covered by the applicable Builder's Risk Policy, except such rights as they may have to the proceeds of such insurance as set forth in the Contract. Contractor will require similar waivers from its Subcontractors, subconsultants, and agents, at any tier.

4.14 Additional Services/Work. It is understood and agreed by the parties hereto that no money will be paid to Contractor for additional labor or materials furnished unless a new contract in writing or a Modification hereof in accordance with the General Conditions and the Contract Documents for such additional labor or materials has been executed. Intermountain specifically reserves the right to modify or amend the Contract and the total sum due hereunder, either by enlarging or restricting the scope of the Work.

4.15 Building Information Modeling. Contractor will perform, throughout the Project, as requested by Intermountain and/or as otherwise required to execute the Project, building information modeling ("BIM") services and coordination among trades. Such BIM services are included in Contractor's Work and services and shall be provided by Contractor and Subcontractors without additional fee or charge to Intermountain. Contractor will provide BIM services using software acceptable to Intermountain.

5. SUBCONTRACTORS.

5.1 Award of Subcontracts and Other Contracts for Portions of the Work.

5.1.1 Approval Required.

a. Listing of Subcontractors will be as stated in the Contract Documents, including but not limited to the "Intermountain Subcontractors List Form".

b. Contractor will not contract with a proposed person or entity to whom Intermountain has made a reasonable and timely objection. Contractor will not be required to contract with anyone to whom Contractor has made reasonable objection.

5.1.2 Business and Licensing Requirements. All Subcontractors used by Contractor will comply with all applicable business and licensing requirements.

5.1.3 Subsequent Changes. After the bid opening, Contractor may change its listed Subcontractors only in accordance with the Contract Documents and with written approval of the Director.

a. Intermountain will pay the additional costs for an Intermountain requested change in Subcontractor if all of the following are met:

(i) If Intermountain in writing requests the change of a Subcontractor;

(ii) The original Subcontractor is a responsible Subcontractor that meets the requirements of the Contract Documents; and

(iii) The original Subcontractor did not withdraw as a Subcontractor on the project.

b. In all other circumstances, Contractor will pay the additional cost for a change in a Subcontractor.

5.1.4 Bonding of Subcontractors. Subcontractors as identified by Intermountain in the procurement documents, may be required to submit performance and payment bonds to cover the full extent of their portion of the Work. This provision does not in any way limit the right of Contractor to have Subcontractors at any tier be required to have a performance and/or payment bond.

5.1.5 Unrelated Subcontractors / Contractor Self-Performed Work.

a. Contractor will procure bids for subcontract work from at least three (3) qualified bidders unless Intermountain waives such requirement in writing. Except as provided in the following section, Contractor will enter into contracts with Subcontractors not owned, related to or controlled by Contractor to perform all portions of the Work. Subcontracts will contain payment provisions consistent with the Contract Documents and will not be awarded on the basis of cost plus a fee without the prior written consent of Intermountain.

b. If Contractor wishes to self-perform any portion of the Work or subcontract such portion of the Work to an entity owned or controlled by or related to Contractor, Contractor will:

1) Advise Intermountain at least thirty (30) Days in advance of bid opening that Contractor wishes to self-perform such Work or subcontract it to an entity owned, controlled by or related to Contractor and request Intermountain's written approval thereof;

2) Submit to Intermountain Contractor's or such related entity's bid at least seventy-two (72) hours prior to bid opening;

3) Procure bids for such subcontract Work from at least three qualified bidders unless Intermountain waives such requirement in writing; and

4) Abide by Intermountain's determination as to whether Contractor or another subcontractor will be used to perform such Work.

c. If Intermountain both approves Contractor to self-perform Work and approves Contractor proceeding without obtaining bids from other Contractors, then Contractor's overhead and profit on Work performed by Contractor's crews will not be more than the percentage fee, if any, stated in the Contractor's Agreement or such fee as agreed by Intermountain and Contractor by

a written Modification executed prior to Contractor's commencing the applicable self-performed Work.

5.2 Subcontractual Relations.

5.2.1 Comply with Contract Documents. By appropriate enforceable agreement, and to the extent it can be practically applied, Contractor will require each Subcontractor to be bound to Contractor by the terms of the Contract Documents, and to assume toward Contractor all the obligations and responsibilities which Contractor, by these Documents, assumes towards Intermountain and A/E.

5.2.2 Rights. Each Subcontractor agreement will preserve and protect the rights of Intermountain and A/E under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and will allow to the Subcontractor, unless specifically provided otherwise in the Subcontractor agreement, the benefit of all rights and remedies against Contractor that Contractor, by the Contract Documents, has against Intermountain.

5.2.3 Sub-Subcontractors. Contractor will require each Subcontractor to enter into similar agreements with its Subcontractors which complies with the requirements of Paragraphs 5.2.1 and 5.2.2 hereinabove.

5.2.4 Document Copies. Contractor will make available to each proposed Subcontractor, before execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound. Subcontractors will similarly make copies of applicable portions of the Contract Documents available to their respective proposed Subcontractors.

5.3 Contingent Assignment of Subcontracts. Each subcontract agreement for a Subcontractor, at any tier for a portion of the Work, is hereby assigned by Contractor to Intermountain provided that the assignment is effective only after termination of the Contract by Intermountain for cause pursuant to Article 12.2 or stoppage of the Work by Intermountain pursuant to Article 12.5, and only for those subcontract agreements which Intermountain accepts by notifying the Subcontractor in writing. The subcontract will be equitably adjusted to meet the new conditions of the work.

6. PROTECTION OF PERSONS AND PROPERTY.

6.1 Safety of Persons and Property.

6.1.1 Contractor Responsibility. Contractor will be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of the Contract. Contractor will take all reasonable precautions for the safety of, and will provide reasonable protection to prevent damage, injury or loss to:

a. Employees on the Work and other persons who may be affected thereby;

b. The Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody or control of Contractor or a Subcontractor; and

c. Other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

6.1.2 Safety Program, Precautions. Contractor will institute a safety program at the start of construction to minimize accidents. This program will continue to the final completion of the Project and conform to applicable laws and regulations including the Utah Occupational Safety and Health Rules and Regulations as published by the Utah Industrial Commission - UOSH Division. Contractor will post signs, erect barriers, and provide those items necessary to implement the safety program. As soon as Contractor proceeds with the Work, Contractor will have all workers and all visitors on the site wear safety hard hats, as well as all other appropriate safety apparel such as safety glasses and shoes, and obey all safety rules and regulations and statutes. Contractor will post a sign in a conspicuous location indicating the necessity of wearing hard hats and Contractor will loan such hats to visitors.

6.1.3 Compliance with Safety Laws. Contractor will give notices and comply with applicable laws, ordinances, rules, codes, regulations and lawful orders of public authorities bearing on safety of persons or property or their protection from damage, injury or loss.

6.1.4 Erect and Maintain Safeguards. Contractor will erect and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including effective fences, posting danger signs and other warnings against hazards, promulgating safety regulations and notifying owners and users of adjacent sites and utilities.

6.1.5 Utmost Care. When use or storage of explosives or other hazardous materials or equipment or unusual methods are necessary for execution of the Work, Contractor will exercise utmost care and carry on such activities under supervision of properly qualified personnel.

6.1.6 Prompt Remedy. Contractor will promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Paragraph 6.1.1 of these General Conditions caused in whole or in part by Contractor, a Subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which Contractor is responsible under this Paragraph 6.1.1, except to the extent such damage or loss is directly due to errors in the Contract Documents or caused by agents or employees of A/E or Intermountain. The foregoing obligations of Contractor are in addition to Contractor's obligations under the Contract Documents.

6.1.7 Safety Designee. Contractor will designate a responsible member of Contractor's organization at the site whose duty will be the prevention of accidents, damage, injury or loss. This person will be Contractor's superintendent unless otherwise designated by Contractor in writing to Intermountain and A/E.

6.1.8 Load Safety. Contractor will not load or permit any part of the construction or site to be loaded so as to endanger its safety.

6.1.9 Off-Site Responsibility. In addition to its other obligations under this Article 6, Contractor will, at its sole cost and expense, promptly repair any damage or disturbance to walls, utilities, streets, ways, sidewalks, curbs and the property of Intermountain and third parties (including municipalities and other governmental agencies) resulting from the performance of the Work, whether by it or by its Subcontractors at any tier. Contractor will not cause materials, including soil and debris, to be placed or left on streets or ways.

6.1.10 Emergencies. In an emergency affecting safety of persons or property, Contractor will act, at Contractor's discretion, to prevent threatened damage, injury or loss. Contractor will promptly notify Intermountain Representative of the action taken.

6.2 Hazardous Materials. In the event Contractor encounters on the site material reasonably believed to be asbestos or polychlorinated biphenyl (PCB) or any other hazardous waste or substance which may endanger the health of those persons performing the Work or being on the site, Contractor will immediately stop Work in the area affected and immediately report the condition to Intermountain Representative and A/E by phone with a follow-up document in writing. The Work in the affected area will be resumed when written direction is provided by Intermountain Representative. Except to the extent provided otherwise in the Contract Documents or if the presence of hazardous materials is due to the fault of Contractor, Contractor will not be required to perform without Contractor's consent, any Work relating to asbestos, polychlorinated biphenyl (PCB) or any other hazardous waste or substance. Intermountain will procure a licensed abatement contractor qualified to remove the hazardous material. The abatement contractor will submit notification of demolition to the Utah Division of Air Quality. Abatement contractor will pay the notification fee. A copy of the hazardous material survey report will be available to all persons who have access to the construction site.

6.3 Historical and Archeological Considerations. In the event Contractor knows or should have known of any cultural, historical or archeological material that is either recognized as an item to be protected under Federal, State, or local law or regulation, or is an item of obvious value to Intermountain, Contractor will cease any work that would interfere with such discovery and immediately report the condition to Intermountain Representative and A/E by phone with a follow-up document in writing. Work will resume based upon the direction of Intermountain Representative. Contractor cooperation with any Intermountain recognized archaeologist or other cultural/historical expert is required.

6.4 Contractor Liability. If Contractor fails in any of its obligations in Articles 6.1 through 6.3 above, Contractor will be liable to any damages to Intermountain or any third party resulting from such noncompliance. Contractor will also be liable for any mitigation or restoration effort resulting from such noncompliance. To the extent all the following is met, Contractor may treat the discovery of such material similarly to an unforeseen condition:

6.4.1 The discovery of such material is reasonably unforeseeable given the site conditions that Contractor should have been aware;

6.4.2 The presence of such material was not identified in any part of the Contract Documents;

6.4.3 Contractor has undertaken all proper action to mitigate any impact of such discovery on the critical path or monies related to the Project;

6.4.4 The discovery affects the critical path or contract price from that which was contemplated by the Contract Documents; and

6.4.5 The requirements of 7.1.5 and the Contract documents are met.

7. MODIFICATIONS, REQUEST FOR INFORMATION, PROPOSED CHANGE ORDER, AND CLAIMS PROCESS.

7.1 Modifications: In General.

7.1.1 Types of Modifications and Limitations. Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or ASI, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents. Contractor must have a written Modification executed by Intermountain under this Article 7 before proceeding with any Work sought to be an extra.

7.1.2 By Whom Issued. A Change Order or Construction Change Directive will be issued by Intermountain Representative. An ASI is issued by A/E. A/E will prepare Change Orders and Construction Change Directives with specific documentation and data for Intermountain's approval and execution in accordance with the Contract Documents, and may issue ASIs not involving an adjustment in the Contract Sum or an extension of the Contract Time which are not inconsistent with the intent of the Contract Documents.

7.1.3 Contractor to Proceed Unless Otherwise Stated. Changes in the Work will be performed under applicable provisions of the Contract Documents, and Contractor will proceed promptly, unless otherwise provided in the Change Order, Construction Change Directive or ASI.

7.1.4 Adjusting Unit Prices. If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are so changed in a PCO or Construction Change Directive that application of such unit prices to quantities of Work proposed will cause a substantial inequity to Intermountain or Contractor, the applicable unit prices may be equitably adjusted.

7.1.5 Changes in the Work Resulting From An Instruction by Intermountain or A/E to Contractor.

a. If Intermountain or A/E gives Contractor an instruction that modifies the requirements of the Contract Documents or delays Substantial Completion, Contractor may be entitled to an adjustment in the Contract Sum and/or the Contract Time. If compliance with the instruction

affects the cost to Contractor to perform the Work, the Contract Sum will be adjusted to reflect the reasonable increase or decrease in cost subject to the conditions set forth in Section 7.1.5, subparagraphs b through g. If compliance with the instruction delays Substantial Completion, the Contract Time will be extended for a period of time commensurate with such delay subject to the conditions set forth in Section 7.1.5, subparagraphs b through g and Section 4.7.13.

b. If Contractor receives an instruction from Intermountain or A/E that Contractor considers to be a Change in the Work, Contractor, before complying with the instruction, will notify A/E in writing that Contractor considers such instruction to constitute a Change in the Work. If A/E agrees that compliance with the instruction will constitute a Change in the Work, Contractor will furnish a proposal for a Modification in accordance with Section 7.1.5 subparagraphs c and d. within ten (10) Days.

c. If Contractor claims that it is entitled to an adjustment in the Contract Sum (including without limitation costs related to a time extension) as a result of an instruction by Intermountain or A/E, Contractor will furnish a proposal for a Change Order containing a price breakdown itemized as required by Intermountain. The breakdown will provide sufficient detail to allow Intermountain to determine any increase or decrease in Direct Costs as a result of compliance with the instruction. Any amount claimed for subcontracts will be supported by a similar price breakdown and will itemize the Subcontractor's profit and overhead charges. Profit and overhead will be subject to the markup limits for additional work, changes, or other Modification set forth in the Contractor's Agreement. Amounts due Intermountain as a result of a credit change will be the actual net decrease in the Contractor's Direct Costs to perform the Work as a result of the Change in the Work. Overhead and profit for the Modification will be calculated based on the net increase or decrease in Contractor's Direct Costs resulting from the Change in the Work.

d. If Contractor claims that it is entitled to an adjustment in the Contract Time as a result of an instruction from Intermountain or A/E, Contractor will include in its proposal justification to support Contractor's claim that compliance with the instruction will delay Substantial Completion.

e. Upon receipt of Contractor's proposal for Modification, A/E and Intermountain will determine whether to proceed with the Change in the Work. If A/E and Intermountain determine to proceed with the Change in the Work, they will execute a Change Order, a Construction Change Directive or a Field Change as appropriate.

f. Contractor agrees that if it complies with an instruction from Intermountain or A/E without first giving written notice to A/E as provided in Section 7.15, subparagraph b, and receiving a Change Order, Construction Change Directive or Field Change, Contractor will not be entitled to any adjustment in the Contract Sum or the Contract Time as a result of the instruction and waives any claim therefor.

g. If Contractor is instructed to perform work which it claims constitutes a Change in the Work but which Intermountain and A/E do not agree constitutes a Change in the Work, Contractor will comply with the instruction. Contractor may submit its claim for adjustment to the Contract Sum, the Contract Time, or both as a dispute pursuant to Section 7.7 within twenty-one (21) Days after compliance with the instruction. Contractor agrees that if it fails to submit its claim for resolution pursuant to Section 7.7 within twenty-one (21) Days after compliance with the instruction, then Contractor will not be entitled to any adjustment in the Contract Sum or the Contract Time as a result of the instruction and waives any claim therefor.

h. Contractor agrees that it is responsible for submitting accurate cost and pricing data to support its Change Order Proposals. Intermountain will have the right to examine the Contractor's records to verify the accuracy and appropriateness of the pricing data used to price change order proposals.

7.1.6 **Change in the Work Resulting From An Event or Circumstance.**

a. If an event or circumstance other than an instruction from Intermountain or A/E affects the cost to Contractor of performing the Work or delays Substantial Completion, Contractor may be entitled to an adjustment in the Contract Sum and/or the Contract Time. If the circumstance or event affects the cost to Contractor to perform the Work and is caused by a willful or negligent act or omission of Intermountain or A/E or an Unforeseen Subsurface Condition, the Contract Sum will be adjusted to reflect the reasonable increase or decrease in Contractor's cost to perform the Work resulting from the event or circumstance, subject to the conditions set forth in Section 7.1.6, subparagraphs b through f. If the event or circumstance delays Substantial Completion and is described in Section 4.7.13, the Contract Time will be extended for a period of time commensurate with such delay subject to the conditions set forth in such section. If the circumstance or event delays Substantial Completion and is caused by a willful or negligent act or omission of Intermountain or A/E or an Unforeseen Subsurface Condition, then Contractor will be compensated for costs incident to the delay in accordance with Section 7.1.6, subparagraphs b through g and Section 4.7.13.

b. Contractor will not be entitled to any adjustment to the Contract Sum or other damages from Intermountain as a result of any event or circumstance unless the event or circumstance results from a willful or negligent act or omission of Intermountain or A/E.

c. If a Change in the Work results from any event or circumstance caused by the willful or negligent act or omission of Intermountain or A/E or an Unforeseen Subsurface Condition, Contractor will give Intermountain Written Notice of such event or circumstance within twenty-four (24) hours after commencement of the event or circumstance so that Intermountain can take such action as is necessary to mitigate the effect of the event or circumstance. Contractor will not be entitled to any adjustment in either the Contract Time or the Contract Sum based on any damages or delays resulting from such event or circumstance during a period more than twenty-four (24) hours prior to Contractor giving such Written Notice to Intermountain.

d. Contractor will submit in writing any claims for an adjustment in the Contract Time and/or the Contract Sum resulting from an event or circumstance within the time limits set forth below. In the event that Contractor fails to submit its claim in writing within the time limits set forth below, then Contractor agrees it will not be entitled to any adjustment in the Contract Time or the Contract Sum or to any other damages from Intermountain due to the circumstance or event and waives any claim therefor.

(i) Claims for an adjustment in the Contract Time due to Adverse Weather will be made within twenty-one (21) Days of the first Day of the occurrence of the Adverse Weather event in which the delay occurred.

(ii) Claims for an adjustment in the Contract Time and/or the Contract Sum due to any other circumstance or event will be submitted within seven (7) Days after the occurrence of the circumstance or event.

e. If Contractor claims that it is entitled to an adjustment in the Contract Sum (including without limitation costs related to a time extension) because of an event or circumstance resulting from the willful or negligent act or omission of Intermountain or A/E or an Unforeseen Subsurface

Condition, Contractor will furnish a proposal for a Change Order containing a price breakdown as described in Section 7.1.5, subparagraph c. Any amount claimed for increased labor costs as a result of the event or circumstance must be supported by a certified payroll. Any claim for rented equipment or additional material costs must be supported by invoices.

f. If Contractor claims that it is entitled to an adjustment in the Contract Time as a result of an event or circumstance, Contractor will include with its claim copies of daily logs, letters, shipping orders, delivery tickets, Project schedules, and other supporting information necessary to justify Contractor's claim that the event or circumstance delayed Substantial Completion.

g. Within thirty (30) Days after receipt of Contractor's claim, A/E will either deny the claim or recommend approval to Intermountain. If Intermountain approves the claim, the adjustment in the Contract Time and/or Contract Sum will be reflected in a Change Order pursuant to Section 7.4 or a Construction Change Directive pursuant to Section 7.5. If Intermountain or A/E denies Contractor's claim, Contractor may submit its claim as a dispute pursuant to Section 7.7 within twenty-one (21) Days of receipt of the denial of the claim. If Contractor fails to submit its claim for resolution pursuant to Section 7.7 within the twenty-one (21) Day time period, then Contractor agrees it is not entitled to any adjustment in the Contract Time and/ or Contract Sum or any other damages as a result of the event or circumstance and waives any claim therefor.

7.2 Contractor Initiated Requests.

7.2.1 The Request for Information, RFI, Process and Time to File. Contractor may file an RFI with A/E regarding any concern which will assist Contractor in the proper completion of the Work including, but not limited to issues related to the Contract Documents, plans and specifications. The RFI will be filed with A/E in a timely manner so as not to prejudice Intermountain as to the quality, time or money related to the Work.

7.2.2 Proposed Change Order. Unless a shorter time period is set forth herein or in other Contract Documents, within twenty-one (21) Days after Contractor knows or should have known of a situation or concern where Contractor is going to request additional monies or time, Contractor must file a PCO with Intermountain Representative, or Contractor will be deemed to waive any right to claim additional monies or time related to such situation or concern. The PCO will include all available documentation supporting the PCO available to Contractor at the time of filing and Contractor will thereafter diligently pursue the supplementation(s) of such documentation and promptly deliver such supplementation(s) to Intermountain Representative.

a. *Intermountain Representative Response*. One of the following may occur after a PCO is filed with Intermountain Representative:

(i) Intermountain Representative, after considering any input by A/E, may reach an agreement with Contractor and issue a Change Order.

(ii) Intermountain, after considering any input by A/E, may issue a Construction Change Directive.

(iii) If Intermountain Representative, after considering any input by A/E, disagrees with Contractor's PCO, Intermountain representative may seek additional information or verification from Contractor, A/E or other sources, may negotiate with Contractor, may issue a Change Order upon such later agreement, may retract the PR, or may issue a Construction Change Directive. A/E must continually work with Intermountain in providing data, documentation and efforts to resolve the issues related to the PR.

7.3 Proposal Request Initiated by Intermountain. Intermountain may file a Proposal Request with Contractor seeking information, data and/or pricing relating to a change in the Contract Time and or monies owing for particular scope changes or other modifications to the Contract Documents. The PR will provide a time limit

for Contractor to file a response with A/E and Intermountain Representative. If a proposal is not timely provided by Contractor, Intermountain may calculate the Change Order under Article 7.4.2 below. Upon such timely receipt of the proposal, one of the following will occur:

7.3.1 If Agreement, Change Order Issued. Intermountain Representative, after considering any input by A/E, may reach an agreement with Contractor and issue a Change Order.

7.3.2 If Disagreement. If Intermountain Representative disagrees with Contractor's proposal, after considering any input from A/E, Intermountain representative may seek additional information or verification from Contractor or other sources, may negotiate with Contractor, may issue a Change Order upon such later agreement, may retract the PR, or may issue a Construction Change Directive. If a Construction Change Directive is issued which identifies Intermountain representative's position in regard to the subject contract sum and/or time adjustment, Contractor must initiate the Claim resolution process provided for herein within twenty-one (21) Days of Contractor's receipt of the Construction Change Directive, or Contractor will be deemed to waive any such request for additional time or money as a result of the issuance of the Construction Change Directive. Such waiver will entitle Intermountain to convert the Construction Change Directive into a Change Order, whether or not executed by Contractor. If the Construction Change Directive leaves open the determination of additional time or money related to the directed change, then the time period for initiating the Claim resolution process will not accrue until such time as Intermountain has conveyed to Contractor a position as to the time and money owing as a result of the directed change.

7.4 Evaluation of Proposal for Issuing Change Orders.

7.4.1 Adjusting Sum Based Upon Agreement. If the Change Order provides for an adjustment to the Contract Sum, the adjustment will be based on the mutual agreement of Contractor and Intermountain, including any terms mandated by unit price agreements or other terms of the Contract Documents.

7.4.2 Intermountain Resolution of Sum and Standards in the Absence of an Agreement Under Paragraph 7.4.1. In the absence of an agreement under Paragraph 7.4.1 above, the adjustment will be based on an itemized accounting of costs and savings supported by appropriate data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Paragraph will be limited to the following:

a. All direct and indirect costs of labor; including workers compensation insurance, social security and other federal and state payroll based taxes, and payroll based fringe benefits paid by Contractor so long as they are reasonable and no higher than that charged to other clients;

b. Costs of materials, on-site temporary facilities, supplies and equipment (except hand tools) required for or incorporated into the work;

c. Rental costs of machinery, equipment, tools (except hand tools), and on-site temporary facilities, whether rented from Contractor or others;

d. Costs of permits and other fees, sales, use or similar taxes related to the Work (with no markup);

e. Additional costs of field supervision and field office personnel directly attributable to the change; and

f. Overhead and profit by the markup limits in the Agreement for additional services or modifications which is not a penalty but a reasonable calculation agreed upon at the time of execution of the Agreement, and provided therein due to the fact that the actual amount due for this overhead and profit cannot easily be ascertained at the time of such execution. The markups set forth in the Agreement are to cover additional payment and performance bond premiums, insurance premiums, home office and on-site overhead and profit. Overhead and profit includes, but is not limited to Contractor's Project Manager and Cost Estimator. Each request for pricing will stand on its own and not be combined with other requests for pricing in determining the

allowed markup. A particular request for pricing will include all items reasonably related together and determinable at the time of the request. If several unrelated requests for pricing are grouped together in a single Change Order, each request for pricing will be considered separately for purposes of calculating the markup.

7.4.3 Credits. The amount of credit to be allowed by Contractor to Intermountain for a deletion or change which results in a net decrease in the Contract Sum will be actual net cost as confirmed to Intermountain based upon corroboration by an appropriate source.

7.5 Construction Change Directives.

7.5.1 When Used and Contractor's Right to Challenge. A Construction Change Directive may be issued by Intermountain Representative in the case of a need for the Work to commence. If the Construction Change Directive leaves open the determination of additional time or money related to the directed change, then the Construction Change Directive will indicate the timeframe(s) in which further information is to be provided to resolve the matter. At any time that Intermountain and Contractor agree upon the time and money related to a Construction Change Directive, a Change Order will be executed by the parties. Additionally, the Construction Change Directive may be converted to a Change Order under Paragraph 7.2.2 or Article 7.3 above.

7.5.2 Proceed with Work and Notify Intermountain about Adjustment Method. Upon receipt of a Construction Change Directive, Contractor will promptly proceed with the change in the Work involved.

7.5.3 Interim Payments by Intermountain. Pending the final determination of the total cost of the Construction Change Directive, Intermountain will pay any undisputed amount to Contractor.

7.6 A/E's Supplemental Instruction (Commonly referred to as an "ASI"). A/E may at any time that is consistent with maintaining the quality, safety, time, budget and function of the Work, issue to Contractor a supplemental instruction ("ASI") after approval from Intermountain Representative is obtained. Contractor must file with Intermountain Representative a PCO under Paragraph 7.2.2 above, within twenty-one (21) Days of Contractor's receipt of the ASI, or the Contactor will be deemed to have waived any right to additional time or monies as a result of such ASI.

7.7 Resolution of Disputes. If a dispute arises between the Parties regarding the Contract Documents which is not resolved by agreement between the parties, before a party may proceed with judicial action, the dispute must be submitted in writing to Intermountain's Vice President of Financial Strategy, Growth and Development, at 36 South State Street, Salt Lake City, Utah 84111. Upon receipt of such written submission, Intermountain will schedule within seven (7) Days an initial conference or meeting, and if necessary within an additional ten (10) Days thereafter a further conference or meeting, as set forth in the escalation process herein below.

7.7.1 Escalation Process. The Parties will arrange in-person meetings or telephone conferences at mutually convenient times and places, according to the levels and time schedules set forth below. The Parties will use reasonable and good faith efforts in this escalation process to respond promptly and to resolve the dispute. Such meetings or conferences will constitute settlement negotiations and any settlement proposal made pursuant to such meetings or conferences will not be admissible as evidence of liability.

Levels and Representatives	Allotted Time Period from Notice or from Previous Level
Level 1	
Contractor's Director level employee, and Intermountain's Director	7 Days
Level 2	
Vice President or higher level executive	10 Days

7.7.2 Judicial Action. In the event that the parties do not resolve their dispute pursuant to the escalation process, either party may commence legal action to resolve the dispute. Any such action must be commenced within six (6) months from the first day of the initial Level 1 conference/meeting or be time barred. Submission of the dispute under the escalation process as outlined above is a condition precedent to the right to commence legal action to resolve any dispute. In the event that either party commences legal action to adjudicate any dispute without first submitting the dispute under the escalation process, the other party will be entitled to obtain an order dismissing the litigation without prejudice and awarding such other party any costs and attorney fees incurred by that party in obtaining the dismissal, including without limitation copy costs, and expert and consultant fees and expenses. Any such legal action must be brought exclusively in the state courts of the State of Utah or in the federal courts of the United States which are located in Salt Lake County, Utah. The Parties hereto hereby agree to submit to the exclusive jurisdiction and venue of such courts for the purposes hereof.

7.7.3 Continuation of Performance During Proceedings. Pending final resolution of a dispute hereunder, Contractor will proceed diligently with the performance of its obligations under the Contract Documents.

7.8 Payment of Claim.

7.8.1 When a standalone component of a Claim has received a final determination, and is no longer subject to review or appeal, that amount will be paid in accordance with the payment provisions of the Contract Documents or judicial order.

7.8.2 When the entire Claim has received a final determination, and is no longer subject to review or appeal, the full amount will be paid within thirty-one (31) Days of the date of the final determination unless the work or services has not been completed, in which case the amount will be paid in accordance with the payment provisions of the Contract Documents to the point that the work or services is completed.

7.8.3 The final determination date is the earlier of the date upon which the claimant accepted the settlement in writing with an executed customary release document and waived its rights of appeal, or the expiration of the appeal period, with no appeal filed, or the determination made resulting from the final appeal.

7.8.4 Any final determination where Intermountain is to pay additional monies to Contractor will not be delayed by any appeal or request for judicial review by another party brought into the process by Intermountain as being liable to Intermountain.

7.8.5 Notwithstanding any other provision of the Contract Documents, payment of all or part of a Claim is subject to any set-off, claims or counterclaims of Intermountain.

7.8.6 Payment to Contractor for a Subcontractor issue (Claim) deemed filed by Contractor, will be paid by Contractor to the Subcontractor in accordance with the contract between Contractor and the Subcontractor.

7.8.7 The execution of a customary release document related to any payment may be required as a condition of making the payment.

7.9 Allocation of Costs of Claim Resolution Process.

7.9.1 Except for attorneys' fees and expert fees, and unless otherwise agreed to by the parties to the Claim, the costs of resolving the Claim will be allocated among the parties on the same proportionate basis as the determination of financial responsibility for the Claim. The costs of resolving the Claim that are subject to allocation include the claimant's filing fee, the costs of any person(s) evaluating the Claim, the costs of making any required record of the process, and any additional testing or inspection procured to investigate and/or evaluate the Claim.

7.9.2 The prevailing party in any Claim, judicial action or other proceeding is entitled to recover its reasonable attorneys' fees, expert and other fees, and costs incurred in the proceeding, in addition to any other relief to which that party may be entitled.

7.10 Alternative Procedures. To the extent otherwise permitted by law, if all parties to a Claim agree in writing, a protocol for resolving a Claim may be used that differs from the process described in this Article 7.

8. PAYMENTS AND COMPLETION.

8.1 Schedule of Values. With the first Application for Payment, Contractor will submit to A/E and Intermountain Representative a schedule of values allocated to all the various portions of the Work. The Schedule of Values will be submitted on the form approved and provided by Intermountain. A/E will make recommendations to Intermountain Representative regarding the Schedule of Values including any suggested modifications. When approved, including any approved modifications, by Intermountain Representative, it will be the basis for future Contractor Applications for Payments. Contractor will not be entitled to payment until receipt and acceptance of the Schedule of Values.

8.2 Applications for Payment.

8.2.1 In General. The following general requirements will be met:

a. Not more than once a month, Contractor will submit to A/E an itemized Application for Payment for Work completed in accordance with the schedule of values and that reflects retainage as provided for in the Contractor's Agreement. Contractor's Applications for Payment will include conditional or final lien waivers (as applicable), in the forms attached to Contractor's Agreement for itself and from each Subcontractor requesting payment, covering all payments requested in the Application for Payment. The Application for Payment will be on a form provided by Intermountain.

b. Such application will be supported by such data substantiating Contractor's right to payment as Intermountain or A/E may require. This data may include, but is not limited to, copies of requisitions from Subcontractors.

c. Such applications may include requests for payment pursuant to approved Change Orders or Construction Change Directives.

d. Such applications may not include requests for payment for portions of the Work performed by a Subcontractor when Contractor does not intend to pay to a Subcontractor because of a dispute or other reason.

e. In executing the Application for Payment, Contractor will attest that Subcontractors involved with prior applications for payment have been paid, unless Contractor provides a detailed explanation why such payment may not have occurred. Intermountain reserves the right to require Contractor to submit a payment waiver from one or more Subcontractors.

8.2.2 Payment for Material and Equipment. Unless otherwise provided in the Contract Documents, payments will be made on account of materials and equipment delivered and suitably stored at the

site for subsequent incorporation in the Work. If approved in advance by Intermountain and A/E, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site will be conditioned upon compliance by Contractor with procedures satisfactory to Intermountain to establish Intermountain's title to such materials and equipment or otherwise protect Intermountain's interest, and will include applicable insurance, storage and transportation to the site for such materials and equipment stored on or off the site. Intermountain may require copies of invoices or other suitable documentation.

8.2.3 Warranty of Title. Contractor warrants that title to all Work covered by an Application for Payment will pass to Intermountain no later than the time for payment. Contractor further warrants that upon submittal of an Application for Payment, all Work for which Certificates for Payment have been previously issued and payments received from Intermountain will, to the best of Contractor's knowledge, information and belief, be free and clear of liens, claims, security interests or encumbrances in favor of Contractor, Subcontractors, or other persons or entities making a claim by reason of having provided labor, materials and/or equipment relating to the Work.

8.2.4 Retainage and Holdback by Intermountain.

a. *Holdback by Intermountain*. Notwithstanding anything to the contrary contained in the Contract Documents, Intermountain may, as a result of the Claim resolution process, withhold any payment to Contractor hereunder if and for so long as Contractor fails to perform any of its obligations hereunder or otherwise is in default under any of the Contract Documents.

b. *Intermountain's Right to Withhold and Use Funds*. Intermountain may withhold from payment to Contractor such amount as, in Intermountain's judgment, may be necessary to pay just claims against Contractor or Subcontractors at any tier for labor and services rendered and materials furnished in and about the Work. Intermountain may apply such withheld amounts for the payment of such claims in Intermountain's discretion. In so doing, Intermountain will be deemed the agent of Contractor and payment so made by Intermountain will be considered as payment made under the Contract by Intermountain to Contractor. Intermountain will not be liable to Contractor for any such payment properly made. Such withholdings and payments may be made without prior approval of Contractor and may also be made before any determination as a result of any dispute, Claim or litigation. However, Contractor will be notified before any such withholding and will be given an opportunity to inform Intermountain as to any reason why the withholding will not occur.

c. *Statutory Retainage*. Notwithstanding and in addition, retainage in the amount of 5% will be withheld from each payment to Contractor for any Work under the Contract. The retainage, including any additional retainage imposed and the release of any retainage, will be in accordance with Intermountain policies, including restrictions of retainage regarding Subcontractors and the distribution of interest earned on the retention proceeds. After Contractor achieves Substantial Completion and submits its payment request for retained funds and provides statutory Conditional Waiver and Release documents executed by all subcontractors and suppliers having claim against the retained funds, Intermountain will pay any unpaid statutory retention, less any offsets or withholdings for specific deficiencies or disputes, within forty-five (45) Days. Notwithstanding the foregoing, Intermountain may (but is not obligated to), in its sole discretion, release from time to time any portion of retention funds for early completing subcontractors and/or otherwise reduce the overall retention funds withheld.

d. *Intermountain Not Responsible for Contractor's Retention Requirements*. Intermountain will not be responsible for enforcing Contractor's obligations under Utah law in fulfilling the retention law requirements with Subcontractors at any tier.

8.2.5 Reimbursement to Intermountain. Notwithstanding any other provision of the Contract, Contractor will reimburse Intermountain for the portion of any expenses paid by Intermountain to Contractor,

which is attributable to Contractor's breach of its duties under the Contract, including the breach of any duty by any Subcontractor or supplier at any tier or anyone for whom Contractor may be liable.

8.3 Certificates for Payment.

8.3.1 Issued by A/E. A/E will within ten (10) Days after receipt of Contractor's Application for Payment, either issue to Intermountain a Certificate for Payment, with a copy to Contractor, for such amount as A/E determines due, or notify Contractor and Intermountain in writing of A/E's reasons for withholding certification in whole or in part as provided in Paragraph 8.4.1. If A/E fails to act within this ten (10) Day period, Contractor may file the Application for Payment directly with Intermountain Representative and Intermountain will thereafter have thirty-one (31) Days from the date of Intermountain's receipt to resolve the amount to be paid and to pay the undisputed amount. The accuracy of Contractor's Applications for Payment will be Contractor's responsibility, not A/E's.

8.3.2 A/E's Representations. A/E's issuance of a Certificate for Payment will constitute a representation to Intermountain that to the best of A/E's knowledge, information and belief, based upon A/E's observations at the site, the data comprising the Application for Payment, and what is reasonably inferable from the observations and data, that the Work has progressed to the point indicated in the Application for Payment and that the quality of the work is in accordance with the Contract Documents. The foregoing representations are subject to minor deviations from the Contract Documents correctable before completion and to specific qualifications expressed by A/E. The issuance of a Certificate for Payment will further constitute a representation that Contractor is entitled to payment in the amount certified. However, the issuance of a Certificate for Payment will not be a representation that A/E has (a) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work, (b) reviewed construction means, methods, techniques, sequences or procedures, (c) reviewed copies of requisitions received from Subcontractors and material suppliers and other data requested by Intermountain to substantiate Contractor's right to payment, (d) ascertained how or for what purpose Contractor used money previously paid on account of Contract Sum, or (e) any duty to make such inquiries.

8.3.3 Contractor Respond to Financial Responsibility and Related Requests, Waivers, Releases, Bonds. Contractor will respond immediately to any inquiry in writing by Intermountain as to any concern of financial responsibility and Intermountain reserves the right to request any waivers, releases or bonds from Contractor in regard to any rights of Subcontractors (including suppliers) at any tier or any third-party before any payment by Intermountain to Contractor.

8.4 Decisions to Withhold Certification.

8.4.1 When Withheld. A/E may decide not to certify payment and may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect Intermountain, if in A/E's judgment the representations to Intermountain required in Paragraph 8.3.2 above cannot be made. If A/E is unable to certify payment in the amount of the Application, A/E will notify Contractor and Intermountain as provided in Paragraph above. If Contractor and A/E cannot agree on a revised amount, A/E will promptly issue a Certificate for Payment for the amount to which A/E makes such representations to Intermountain. A/E may also decide not to certify payment or, because of subsequently discovered evidence or observations, may nullify the whole or part of a Certificate for Payment previously issued, to such extent as may be necessary in A/E's opinion to protect Intermountain from loss because of:

a. Defective Work not remedied;

b. Third party claims filed or reasonable evidence indicating probable filing of such claims;

c. Failure of Contractor to make payments properly to Subcontractors or for labor, materials or equipment;

d. Reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;

e. Damage to Intermountain or another contractor;

f. Reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or

g. Failure to carry out the Work in accordance with the Contract Documents.

8.4.2 Certification Issued When Reasons for Withholding Removed. When the reasons stated in Paragraph 8.4.1 for withholding certification are removed, certification will be made for such related amounts.

8.4.3 Continue Work Even If Contractor Disputes A/E's Determination. If Contractor disputes any determination by A/E or the result of the Claim resolution process with regard to any Certification of Payment, Contractor nevertheless will expeditiously continue to prosecute the Work.

8.4.4 Intermountain Not in Breach. Intermountain will not be deemed to be in breach of this Contract by reason of the withholding of any payment pursuant to any provision of the Contract Documents provided Intermountain's action or such withholding is consistent with the results of the dispute resolution process.

8.5 Progress Payments.

8.5.1 In General, Interest on Late Payments.

a. Except as provided in Paragraph 8.3.1, Intermountain will pay any undisputed amount within thirty-one (31) Days of satisfaction of the following requirements: (i) Contractor has submitted the application for payment; (ii) A/E has issued to Intermountain a Certificate recommending payment; (iii) Contractor has obtained conditional or unconditional waiver and release documents executed by all of Subcontractors performing work and/or providing materials covered by the Contractor's payment request; and (iv) Contractor has provided all "as-built" drawings to A/E sufficient for A/E to compile and provide a final set of Record Drawings for each completed phase and for all portions of the Project for which a certificate of occupancy is issued. In no event will Intermountain be required to pay any disputed amount.

b. Except as otherwise provided by law, if any payment is made more than sixty (60) Days after receipt by Intermountain of the applicable invoice (with any required supporting documentation), the late payment will bear interest from the due date until payment is made at the rate of five percent (5%) per annum.

8.5.2 Contractor and Subcontractor Responsibility. Contractor will promptly pay each Subcontractor, upon receipt of payment from Intermountain, out of the amount paid to Contractor on account of such Subcontractor's portion of the Work, the amount to which this Subcontractor is entitled. Contractor will, by appropriate agreement with each Subcontractor, require each Subcontractor to make payment to its Subcontractors in a similar manner.

8.5.3 Information Furnished by A/E Or Intermountain to Subcontractor. A/E or Intermountain will, on request, furnish to the Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by Contractor and action taken thereon by A/E and Intermountain on account of portions of the Work done by such Subcontractor.

8.5.4 Intermountain and A/E Not Liable. Neither Intermountain nor A/E will have an obligation to pay, monitor or enforce the payment of money to a Subcontractor, except to the extent as may otherwise be required by law.

8.5.5 Certificate, Payment or Use Not Acceptance of Improper Work. A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by Intermountain will not constitute acceptance of Work that is not in accordance with the Contract Documents.

8.6 Payment upon Substantial Completion. Upon Substantial Completion of the Work or designated portion thereof and upon application by Contractor and certification by A/E, Intermountain will make payment, reflecting adjustment in retainage, if any, for such Work or portion thereof as provided in the Contract Documents. To the extent allowed by law, Intermountain may retain up to 200% of the fair market value of the work that has not been completed in accordance with the Contract Documents.

8.7 Partial Occupancy or Use.

8.7.1 In General. Intermountain may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with Contractor, and authorized by public authorities having jurisdiction over the Work. Such partial occupancy or use may commence whether or not the portion is Substantially Complete, provided Intermountain and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of the warranties required by the Contract Documents. When Contractor considers a portion to be substantially complete, Contractor will prepare and submit a list to A/E as previously provided for herein. Consent of Contractor to partial occupancy or use will not be unreasonably withheld. Contractor will have continuing responsibility to protect the unoccupied portions of the site and the Work during such partial occupancy and will be responsible for damage except to the extent caused solely by Intermountain during such partial occupancy or use.

The stage of progress of the Work will be determined by written agreement between Intermountain and Contractor.

8.7.2 Inspection. Immediately before such partial occupancy or use, Intermountain, Contractor and A/E will jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

8.7.3 Record Drawings**.** Contractor will provide all "as-built" drawings to A/E and A/E will then provide to Intermountain within forty-five (45) Days of any partial occupancy a final set of Record Drawings for the occupied phase or portion of the Project.

8.7.4 Not Constitute Acceptance. Except to the extent it is agreed upon in writing by Intermountain, partial occupancy or use of a portion or portion of the Work will not constitute acceptance of Work not complying with the requirement of the Contract Documents.

8.8 Final Payment.

8.8.1 Certificate for Payment. A/E's final Certificate for Payment will constitute a further representation that the conditions listed in Paragraph 8.8.2 as precedent to Contractor's being entitled to final payment have been fulfilled.

8.8.2 Conditions for Final Payment. Neither final payment nor any remaining retained percentage will become due until Contractor submits to A/E the following to the extent required by Intermountain Representative:

a. A final payment request;

b. Waiver and release upon final payment documents executed by all of the Subcontractors performing work and/or providing materials covered by the Contractor's final payment request;

c. An executed Substantial Completion form, which includes remaining Project items to be completed, Final Certificate of Occupancy from the applicable municipality, fire clearance(s) from Fire Marshal, Approval(s) from applicable State Dept. of Health, and any other permits/approvals for occupancy of Project as required by authorities with jurisdiction over the Project;

d. Evidence satisfactory to Intermountain that all required utilities are installed, commissioned, and operating consistent with the Specifications;

e. Confirmation of completion of any review or, if applicable, audit of Contractor's Payment Applications and reconciliation, as required by Intermountain;

f. All manufacturers' and other guaranties and warranties, properly signed and endorsed to Intermountain, that are required by the Contract Documents that extend for a period beyond one year after substantial completion. (Delivery of such guaranties and warranties will not relieve Contractor for any obligation assumed under any other provision of the Contract Documents.);

g. An affidavit that payrolls, bills for material and equipment, and other indebtedness connected with the Work for which Intermountain's property might be responsible or encumbered (less amounts withheld by Intermountain) have been paid or otherwise satisfied;

h. A current or additional certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and will not be canceled or allowed to expire until at least thirty (30) Days prior written notice, by certified mail, return receipt requested, has been given to Intermountain;

i. A written statement that Contractor knows of no substantial reason that the insurance will not be renewable to cover the period required by the Contract Documents;

j. If requested by surety in a timely manner or by Intermountain, consent of surety, to final payment;

k. Up to date "as-built" Drawings certified by Contractor as accurate and complete, Specifications, Addenda, Change Orders and other Modifications maintained at the site; the warranties, instructions, operation and maintenance manuals, and training videos required to be furnished by the Contract Documents;

l. Other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances arising out of the Contract, to the extent and in such form as may be designated by Intermountain. If a Subcontractor refuses to furnish a release or waiver required by Intermountain, Intermountain may require consent of surety to the final payment. If such liens, claims, security interests or encumbrances remain unsatisfied after payments are made, Contractor will refund to Intermountain all money that Intermountain may be compelled to pay in discharging such lien, including all costs and reasonable attorneys' fees; and

m. A written statement demonstrating how Contractor will distribute interest earned on retention to Subcontractors as required by Section 13.8.5, U.C.A.

In addition, A/E must declare to Intermountain in writing that the Work is complete and provide a final set of Record Drawings. If the aggregate of previous payments made by Intermountain exceeds the amount due Contractor, Contractor will reimburse the difference to Intermountain within ten (10) Days of Intermountain's request.

8.8.3 Waiver of Claims: Final Payment. The making of final payment will not constitute a waiver of Claims or other rights by Intermountain.

8.8.4 Waiver by Accepting Final Payment. Acceptance of final payment by Contractor or a Subcontractor will constitute a waiver of Claims by that payee except those Claims previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

8.8.5 Time of Repose and Waiver. In addition and notwithstanding, claims and invoices for work, equipment, services, or materials that are not submitted to Intermountain within one (1) year of Substantial Completion of the Project are completely void and unenforceable as against Intermountain. Contractor and all Subcontractors hereby waive all rights and claims against Intermountain attendant such claims and invoices, and Contractor will contractually obligate each Subcontractor to waive all rights and claims against Intermountain attendant such claims and

invoices. This provision imposes an absolute cut off on the timing for submitting such claims and invoices; this provision does not lengthen any timing requirements in the Contract Documents.

9. TESTS AND INSPECTIONS, SUBSTANTIAL AND FINAL COMPLETION, UNCOVERING, CORRECTION OF WORK, AND GUARANTY PERIOD.

9.1 Tests and Inspections.

9.1.1 In General. Tests, inspections and approvals of portions of the Work required by the Contract Documents or by laws, ordinances, rules, regulations, resolutions or orders of public authorities having jurisdiction will be made at an appropriate time. Unless otherwise specifically set forth in the Contract Documents or agreed to by Intermountain in writing, Intermountain will contract for such tests, inspections and approvals with an independent entity, or with the appropriate public authority, and Intermountain will bear all related costs of tests, inspections and approvals except as provided below. If any of the Work is required to be inspected or approved by the terms of the Contract Documents or by any public authority, Contractor will, at least two working days before the time of the desired inspection, and following the procedures established by Intermountain, request such inspection or approval to be performed. Contractor will give A/E timely notice of when and where tests and inspections are to be made so that A/E may observe such procedures.

9.1.2 Failure of An Inspector to Appear. Work will not proceed without any required inspection and the associated authorization by Intermountain to proceed unless the following procedures and requirements have been met:

a. The inspection or approval was requested in a timely manner as provided in Paragraph 9.1.1;

b. Contractor received written confirmation from the inspection entity that the inspection was scheduled;

c. Contractor has contacted or attempted to contact the inspector to confirm that the inspector is unable to perform the inspection as scheduled;

d. If the inspector has confirmed that it is unable to perform the inspection as scheduled or if Contractor is unable to contact the inspector, Contractor will attempt to contact Intermountain Representative for instruction; and Contractor has documented the condition of the work before being covered through photos or other means.

9.1.3 Nonconforming Work. If such procedures for testing, inspection or approval under Paragraph 9.1.1 reveal failure of portions of the Work to comply with the requirements established by the Contract Documents, Contractor will bear all costs made necessary by such failure including those of repeated procedures and compensation for Intermountain's expenses, including the cost of retesting for verification of compliance if necessary, until Intermountain accepts the Work in question as complying with the requirements of the Contract Documents.

9.1.4 Certificates. Required certificates of testing, inspection or approval will, unless otherwise required by the Contract Documents, be secured by Contractor and promptly delivered to A/E.

9.1.5 A/E Observing. If A/E is to observe tests, inspections or approvals required by the Contract Documents, A/E will do so with reasonable promptness and, where practicable, at the normal place of testing.

9.1.6 Promptness. Tests, inspections and arrangements for approvals conducted pursuant to the Contract Documents will be made promptly to avoid unreasonable delay in the Work.

9.2 Inspections: Substantial and Final.

9.2.1 Substantial Completion Inspection. Before requesting a substantial completion inspection, Contractor will prepare a comprehensive initial punchlist, including unresolved items from prior inspections, for review by Intermountain and A/E to determine if the Project is ready for a substantial completion inspection. If Intermountain determines that the initial punchlist indicates that the Project is not

substantially complete, the initial punchlist will be returned to Contractor with written comments. If Intermountain determines that the initial punchlist indicates that the Project may be substantially complete, A/E will promptly organize and perform a Substantial Completion inspection in the presence of Intermountain and all appropriate authorities.

a. If A/E reasonably determines that the initial punchlist prepared by Contractor substantially understates the amount of the Work remaining to be completed and the Project is not substantially complete, A/E will report this promptly to Intermountain, and upon concurrence of Intermountain, Contractor will be assessed the costs of the inspection and punchlist preparation incurred by A/E and Intermountain.

b. When the Work or designated portion thereof is Substantially Complete, A/E will prepare a Certificate of Substantial Completion which will establish the date of Substantial Completion; will establish responsibilities of Intermountain and Contractor for security, maintenance, heat, utilities, damage to the work and insurance; and will fix the time within which Contractor will finish all items on the punchlist accompanying the Certificate. The Certificate of Substantial Completion will require approval by Intermountain Representative. If there is a punchlist, Contractor will proceed promptly to complete and correct items on the list. Failure to include an item on the punchlist does not alter the responsibility of Contractor to complete all Work in accordance with the Contract Documents.

c. Warranties required by the Contract Documents will commence on the date of Substantial Completion of the Work or designated portion thereof except to the extent as provided otherwise in the Contract Documents or if such warranty is related to an item where the work is not complete. Such warranty documents will state the length of the warranty, which must comply with the Contract Documents.

d. The Certificate of Substantial Completion will be submitted by A/E to Intermountain and Contractor for their written acceptance of responsibilities assigned to them in such Certificate.

e. Except to the extent Intermountain Representative otherwise approves in advance and in writing, Contractor will submit the following documents in order to achieve Substantial Completion: written warranties, guarantees, operation and maintenance manuals, and all complete “as-built” Drawings. Contractor must also provide or obtain any required approvals for occupancy, and deliver “as-built” drawings to A/E sufficient to enable A/E to compile and provide a final set of Record Drawings for each completed phase and for each area for which a certificate of occupancy is issued within forty-five (45) Days of such issuance. Contractor is responsible for the guaranty of all Work, whether performed by it or by its Subcontractors at any tier.

9.2.2 Final Completion Inspection. Before requesting a final inspection, Contractor will verify all punchlist items are corrected/completed. Once all punchlist items are corrected/completed Contractor will notify Intermountain and request a final inspection. Intermountain will notify A/E and perform a final inspection. Two final inspections may be allowed due to required weather changes required to complete some items. When all punchlist items are completed a final pay request will be provided by Contractor, authorized by A/E and processed by Intermountain.

9.3 Uncovering of Work.

9.3.1 Uncover Uninspected Work. Except as provided in Paragraph 9.3.3, if a portion of the Work is covered before an Inspector’s approval to proceed, it must, be uncovered for the Inspector’s inspection and be replaced at Contractor’s expense without change in the Contract Time.

9.3.2 Observation before Covering. Except as provided in Paragraph 9.3.3, if Intermountain or A/E has requested in writing to observe conditions before any Work being covered or if such observation is specified in the Contract Documents, and the Work is covered without such observation, Contractor will be required to uncover and appropriately replace the Work at Contractor’s expense without change in the Contract Time. If Contractor requests an inspection and Intermountain or A/E, including

any inspector of each, does not appear, Contractor will immediately notify Intermountain of such lack of appearance, but will not cover the Work without such inspection.

9.3.3 When an Inspector Fails to Appear Or A/E Or Intermountain Did Not Make Prior Request. If Work is performed by Contractor without an inspection as provided in Paragraph 9.1.2 or if a portion of the Work has been covered which A/E or Intermountain has not specifically requested to observe before its being covered or such observation is not specified by the Contract Documents, A/E or Intermountain may request to see such Work and it will be uncovered by Contractor. If such Work is in accordance with the Contract Documents, costs of uncovering and replacement, will, by appropriate Change Order, be charged to Intermountain. If such Work is not in accordance with the Contract Documents, Contractor will pay such costs unless the condition was caused by Intermountain or a separate contractor in which event Intermountain will be responsible for payment of such costs.

9.4 Correction of Work and Guaranty Period.

9.4.1 Contractor Correct the Work. Contractor will correct Work rejected by A/E, Inspector or Intermountain, or failing to conform to the requirements of the Contract Documents, whether observed before or after Substantial Completion and whether or not fabricated, installed or completed. Contractor will bear the costs of correcting such rejected Work, including additional testing and inspections and compensation for A/E's and Inspector's services and expenses made necessary thereby.

9.4.2 Guaranty and Correction after Substantial Completion. If within one year after the date of Substantial Completion of the Work or designated portion thereof, or after the date for commencement of warranties established under Paragraph 9.2.1 or by terms of an applicable special warranty or guaranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, including failure to perform for its intended purpose, Contractor will correct it promptly after receipt of written notice from Intermountain to do so unless Intermountain has previously given Contractor a written acceptance of such condition. The period of one year will be extended with respect to portions of the Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual performance of the Work. This obligation of Contractor under this Paragraph 9.4.2 will be operative notwithstanding the acceptance of the Work under the Contract, the final certificate of payment, partial or total occupancy and/or termination of the Contract. Intermountain will give notice of observed defects with reasonable promptness, however, failure to give such notice will not relieve Contractor of its obligation to correct the Work at the cost that Contractor would have incurred if Intermountain did so report with reasonable promptness. All corrected Work will be subject to a one-year guaranty period the same in all respects as the original Work, except that such guaranty period will commence from the time of Substantial Completion of the corrected Work. This guaranty period does not affect Intermountain's right to pursue any available remedies against Contractor.

9.4.3 Removal of Work.

a. Contractor will promptly remove from the premises all Work that Intermountain and/or A/E determines as being in nonconformance with the Contract Documents, whether incorporated or not.

b. Contractor will promptly replace and re-execute the Work in accordance with the Contract Documents and without expense to Intermountain.

c. Contractor will bear the expense of correcting destroyed or damaged construction, whether completed or partially completed, of Intermountain or of other contractors destroyed or damaged by such removal or replacement.

d. If Contractor does not remove such rejected Work within a reasonable time, fixed by written notice, Intermountain may have the materials removed and stored at the expense of Contractor.

e. If Contractor does not correct the nonconforming Work within a reasonable time, fixed by written notice, Intermountain may correct it in accordance with Paragraph 12.2.2 of these General Conditions.

9.4.4 Not Limit Other Obligations. Nothing contained in this Article 9.4 will be construed to establish a period of limitation with respect to other obligations which Contractor may have under the Contract Documents. Establishment of the time period of one year as described in Paragraph 9.4.2 relates only to the specific obligation of Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish Contractor's liability with respect to Contractor's obligations other than specifically to correct the Work.

9.5 Additional Warranties.

9.5.1 In General. In addition to any other provisions of this Article 9, the following warranties will apply:

a. Contractor warrants to Intermountain that materials and equipment furnished under the Contract will be of good quality and new, except to the extent otherwise required or expressly permitted by the Contract Documents.

b. Contractor also warrants to Intermountain that the Work will be free from defects not inherent in the quality required or permitted and that the Work will conform to the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered Defective at Intermountain's option.

9.5.2 Correction of Work.

a. Contractor will promptly correct any portion of the Work which is rejected by A/E, the inspector, or Intermountain, or which fails to conform to the requirements of the Contract Documents, whether observed before or after Substantial Completion and whether or not fabricated, installed, or completed. Contractor will bear the cost of correcting such rejected Work, including additional testing and inspection costs, compensation for A/E's services, and any other expenses made necessary thereby. Such costs will in no way be payable by Intermountain and will not increase the Contract Sum.

b. Contractor will remedy any Defects due to faulty materials, equipment, or workmanship which appear within a period of one (1) year from the date of Substantial Completion or within such longer period of time as may be prescribed by law or by the terms of any applicable special warranty required by the Contract Documents. Contractor will pay all costs of correcting faulty work, including additional A/E fees, attorney fees, expert fees, consultant fees, copy costs, and other expenses when incurred. Such costs will in no way be payable by Intermountain and will not increase the Contract Sum.

c. Nothing in the Contract Documents will be construed to establish a period of limitation within which Intermountain may enforce the obligation of Contractor to comply with the Contract Documents. The one (1) year period specified in paragraph 9.5.2(2) has no relationship to the time within which Intermountain may enforce compliance with the Contract Documents, nor to the time within which proceedings may be commenced to establish Contractor's liability with respect to Contractor's obligations.

9.5.3 Exclusion. Unless due to the negligent or intentional act or omission of Contractor or those under Contractor's control, or as otherwise stated in the Contract Documents, Contractor's guaranty excludes remedy for damage or defect caused by abuse, modifications not executed by Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear under normal usage.

9.5.4 Furnish Evidence on Request. If requested by A/E or Intermountain, Contractor will furnish satisfactory evidence as to the type and quality of materials and equipment.

9.6 Acceptance of Nonconforming Work. If Intermountain prefers to accept Work which is not in accordance with the requirements of the Contract Documents, Intermountain may do so in writing instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment will be effected whether or not final payment has been made. Without limitation, usage by Intermountain or A/E of mechanical devices, machinery, apparatus, equipment, or other work or materials supplied under the Contract Documents before written acceptance by Intermountain, will not constitute Intermountain's acceptance.

10. INSURANCE AND BONDS.

10.1 Insurance. To protect against liability, loss and/or expense arising in connection with the performance of services described under the Contract Documents, Contractor will obtain and maintain in force as set forth below in section 10.1.9 without interruption, the following stated insurance, in a form and content satisfactory to Intermountain, from insurance companies authorized to do business in the State in which the Project is located with an A.M. Best's Rating of A- or better and Class VII or better. Contractor will require all Subcontractors to have and maintain similarly required policies. All of the following listed insurance coverages will be provided by Contractor.

10.1.1 Contractor's Commercial General Liability Insurance. Contractor will maintain coverage, with ISO Form CG 00 01 or other policy form satisfactory to Intermountain, on an occurrence basis, including coverage for Premises-Operations, Independent Contractors' Protective, Products-Completed Operations, Contractual Liability, Personal Injury, and Broad-Formed Property Damage (including coverage for Explosion, Collapse, and Underground hazards), which will provide primary coverage to the additional insureds (Intermountain and the A/E) in the event of any occurrence, claim, or suit, with per occurrence and annual aggregate policy limits of at least as follows:

$2,000,000	General Aggregate;
$2,000,000	Products-Completed Operations Aggregate;
$1,000,000	Personal and Advertising Injury;
$1,000,000	Each Occurrence.

Intermountain reserves the right to require additional coverage limits of liability from that stated above. Intermountain also reserves the right to require project specific insurance, and if such right has been exercised it will be indicated in the Contract Documents.

10.1.2 Excess and Umbrella Liability Insurance. Contractor will maintain excess and liability insurance with coverage at least as broad as the underlying liability insurance described in this section, written on an occurrence basis with per occurrence and annual aggregate policy limits based on the following chart, unless modified by mutual agreement of the parties,

Small Project ($2,000,000 or less)
Minimum Commercial General Liability Coverage
$1,000,000 each occurrence,
$3,000,000 general aggregate

Medium Project ($2,000,001 to $10,000,000)
Minimum Commercial General Liability Coverage
$5,000,000 each occurrence,
$10,000,000 general aggregate

Large Project (Greater than $10,000,000)
Minimum Commercial General Liability Coverage

$10,000,000 each occurrence,
$20,000,000 general aggregate

For insurance purposes, the size of the Project will be specified in the Contractor's Agreement. Such excess or umbrella liability policy will follow form with the primary liability policies, and contain a drop-down provision in case of impairment of underlying limits.

10.1.3 Workers' Compensation Insurance and Employers' Liability Insurance. Worker's Compensation Insurance will cover full liability under the Worker's Compensation Laws of the jurisdiction in which the Project is located at the statutory limits required by this jurisdiction's laws. Contractor will also maintain Employer's Liability Insurance with limits of at least $1,000,000 each accident, $1,000,000 for bodily injury by accident, and $1,000,000 each employee for injury by disease. Contractor will collect and keep on-file evidence that Contractor and all tiers of Subcontractors have current certificates of this Workers Compensation Insurance (as required by State statute) as well as Employer's Liability Insurance, and will produce them upon request by Intermountain.

10.1.4 Automobile. Automobile liability insurance for claims arising from the ownership, maintenance, or use of a motor vehicle. The insurance will be written on an "occurrence" form and will apply to "any auto" and will cover all owned, non-owned, and hired automobiles used in connection with the work, with the following minimum limits of liability: $1,000,000 – Combined Single Limit Bodily Injury and Property Damage per Occurrence.

10.1.5 Pollution Liability Insurance. Pollution Liability Insurance covering Contractor's or appropriate Subcontractor's liability for bodily injury, property damage and environmental damage resulting from sudden, accidental, and gradual pollution and related cleanup costs incurred by Contractor, all arising out of the goods delivered or Work and services performed (including transportation risk) under this Contract, is required with limits of at least $1,000,000 per claim and $1,000,000 annual aggregate.

10.1.6 Aircraft Use. Contractor using its own manned or unmanned aircraft, or employing manned or unmanned aircraft in connection with the work performed under the Contract Documents will maintain Aircraft Liability Insurance with a combined single limit of not less than $1,000,000 per occurrence. This certificate will state that the policy required by this paragraph has been endorsed to name Intermountain as an Additional Insured.

10.1.7 Policy Aggregate(s). Unless project specific insurance is required by Intermountain, the above insurance coverages will be written or endorsed under a policy to have general, per occurrence, and aggregate limits of liability applicable to this project only.

10.1.8 Certificates. Before the Contract Documents are executed, Contractor will submit certificates in form and substance satisfactory to Intermountain as evidence of the insurance requirements of this Article 10. Contractor will obtain copies of Additional Insured (Ongoing and Completed Operations), Waiver of Subrogation, and Primary and Non-Contributory Endorsements and/or policy clauses. The certificates will contain provisions that no cancellation, or non-renewal will become effective except upon thirty (30) Days prior written notice by US Mail to Intermountain as evidenced by return receipt, certified mail sent to Intermountain. Contractor will notify Intermountain within thirty (30) Days of any claim(s) against Contractor which singly or in the aggregate exceed 20% of the applicable required insured limits and Contractor will, if requested by Intermountain, use its best efforts to reinstate the policy within the original limits and at a reasonable cost. Intermountain will be named as an additional insured party, as primary coverage and not contributing, on all the insurance policies required by this Article, except the professional liability and workers' compensation policies, by endorsements satisfactory to Intermountain -- using a combination of ISO forms CG 20 10 (07/04), Additional Insured – Owners, Lessees or Contractors – Scheduled Person or Organization and CG 20 37 (07.04) Additional Insured – Owners, Lessees or Contractors – Completed Operations, or other forms acceptable to Intermountain, naming Intermountain and A/E as additional insureds. Intermountain reserves the right to request Contractor to provide a loss report from its insurance carrier. Contractor will collect and keep on-file evidence that Contractor and each Subcontractor has

current certificates of Commercial General Liability Insurance, Excess /Umbrella Liability Insurance, and other insurance required herein, and will produce them upon request by Intermountain.

10.1.9 Maintain throughout Contract Documents Term. Contractor will maintain, from commencement of the Work, insurance coverage required in Articles 10.1 and 10.2 as follows:

a. Commercial General Liability Insurance through expiration of the statute of limitations/repose for completed operations, but in no event less than ten (10) years from completion of the Project; and

b. All other insurance through final payment.

10.1.10 Waivers of Subrogation. Contractor waives all rights against Intermountain and other additional insureds for recovery of damages to the extent the losses and damages are covered by existing insurance, including without limitation commercial general liability, commercial excess/umbrella liability, business auto liability, workers compensation or employer's liability insurance, and pollution liability insurance. Contractor will ensure that all insurance policies required herein will be endorsed to include waivers of subrogation in favor of Intermountain. Contractor hereby waives all rights of subrogation against Intermountain.

10.1.11 Excess Coverages. Any type of insurance or any increase of limits of liability not described in the Contract Documents which Contractor requires for its own protection or on account of any statute, rule or regulation, will be its own responsibility and at its own expense.

10.1.12 Not Relieve Contractor of Liability. The carrying of any insurance required by the Contract Documents will in no way be interpreted as relieving Contractor of any other responsibility or liability under the Contract Documents or any applicable law, statute, rule, regulation, or order.

10.1.13 Contractor Compliance with Policies. Contractor will not violate or permit to be violated any of the provisions of the insurance policies required under the Contract.

10.1.14 Deductible Liability. Any and all deductibles in the above described policies will be assumed by, for the account of, and at the sole risk of Contractor. The allowable deductible for any of the Contractor insurance policies required by these General Conditions shall be no less than $1,000 or 0.1 percent of the Contract Amount, whichever is greater.

10.2 "Builder's Risk" Property Insurance.

10.2.1 In General. Intermountain will provide through Substantial Completion "Builder's Risk" property insurance for the cost of the Project. The policy will be written on an all risk basis, with exclusions standard for the insurance industry, on policy forms currently and commercially available, with insurance carriers selected by Intermountain.

10.2.2 Deductible. The above described "Builder's Risk" policies shall be subject to a total deductible of $5,000 per loss occurrence, which deductible shall be assumed by Contractor or Subcontractors, in proportion to their share of the total amount of an insured loss occurrence.

10.2.3 Waiver. To the extent damages are covered by the above described "Builder's Risk" policies, Contractor, including all Subcontractors and Material Suppliers, and Intermountain hereby waive all rights against each other for damages caused by perils insured against under the "Builder's Risk" insurance provided. Contractor will require similar waivers from each of their contractors, subcontractors, material suppliers, sub-consultants and agents, at any tier.

10.2.4 Policy Terms. Intermountain will provide a copy of the terms and conditions of the builders risk policy to Contractor upon Contractor's request. Contractor will comply with terms, conditions, and deadlines of the builders risk policy. The terms, conditions, and deadlines of the builders risk policy shall govern coverage. Contractor will cooperate with Intermountain and the builders risk commercial insurer in the investigation, documentation, and settlement of loss claims, including

without limitation promptly responding to all requests for information and documentation from the builders risk commercial insurer and/or Intermountain.

10.2.5 Special Hazards. Intermountain will bear the risk of loss, delay and/or damage due to earthquake and/or flood and may either insure or self-insure that risk.

10.3 Performance Bond and Payment Bond. If required by the Contract Documents, Contractor will before commencement of the Work or within ten (10) Days after signing the Agreement, whichever is earlier, submit and maintain in full force and effect as required by law and the Contract Documents, as part of the Construction Costs for the Project, written on Form AIA Document A312 (1984) or on other forms provided by Intermountain, and include as part of the quoted total all costs involved in securing and furnishing, a performance bond and a labor and material payment bond the bonds listed below, based on the completed cost of the Contract and effective upon execution of the Contract. These bonds will be from a surety company or companies licensed in the state in which the Project is located and holding valid certificates of authority under Sections 9304 to 9308, Title 31, of the United States Code as acceptable sureties or reinsurance companies on federal bonds, have a penal sum obligation not exceeding the authorization shown in the current revision of Circular #570 as issued by the United States Treasury Department, i.e. "Treasury List", and be accompanied by a certified copy of the power of attorney stating the authority of the attorney-in-fact executing the bonds on behalf of the surety.

a. A full 100 percent performance bond covering the faithful execution of the Contract in accordance with the Contract Documents; and

b. A full 100 percent payment bond covering payment of all obligations arising under the Contract Documents, for the protection of each person supplying labor, service, equipment, or material for the performance of the Work.

All Subcontractor performance and payment bonds will name Contractor and Intermountain as Obligee. Intermountain reserves the right to reject any surety company, performance bond, or labor and material payment bond with or without cause.

10.4 Intermountain Self-Insurance. Intermountain may, at its option, satisfy any insurance requirements applicable to Intermountain through its self-insurance and risk management program.

11. MISCELLANEOUS PROVISIONS.

11.1 A/E's Responsibilities. These General Conditions are not intended to provide an exhaustive or complete list of A/E's responsibilities. A separate agreement between Intermountain and A/E incorporates these General Conditions by reference and includes additional design responsibilities.

11.2 Successors and Assigns. Intermountain and Contractor respectively bind themselves, to the other party in respect to covenants, agreements and obligations contained in the Contract Documents. Contractor will not assign the Contract, or any of its rights or obligations under the Contract, without the prior written consent of Intermountain, nor will Contractor assign any amount due or to become due as well as any rights under the Contract, without prior written consent of Intermountain. Intermountain may assign the Contract to an institutional lender providing financing for the Project. In such event, the lender will assume Intermountain's rights and obligations under the Contract. Contractor will execute all consents reasonably required to facilitate such assignment.

11.3 Written Notice. Written notice will be deemed to have been duly served if (a) delivered in person to the individual or a member of the firm or entity or to an officer of the corporation for which it was intended, or (b) delivered at or sent by registered or certified mail, return receipt requested, or (c) deposited for delivery with a nationally recognized overnight courier service, to the last business address known to the party giving notice.

11.4 Rights and Remedies.

11.4.1 Not Limit. Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder will be in addition to and not a limitation of duties, obligations, rights and remedies otherwise imposed or available by law.

11.4.2 Not Waiver. Except as expressly provided elsewhere in the Contract Documents, no action or failure to act by Intermountain, A/E or Contractor will constitute a waiver of a right or duty afforded them under the Contract Documents, nor will such action or failure to act constitute approval or acquiescence in a breach thereunder, except as any of the above may be specifically agreed to in writing. In no case will Contractor or any Subcontractors be entitled to rely upon any waiver of any of these General Conditions unless agreed to in writing by Intermountain.

11.5 Use of Intermountain Forms. Unless otherwise specifically identified in the Contract, all references or requirements for use or submission of documents to Intermountain, to A/E, or to others must be on Intermountain's approved forms. These forms include, without limitation, pay application, requests for payment, proposed change orders, change orders, modifications, requests for information, continuation sheets, waiver and lien releases, verifications, and other project related documents. Notwithstanding, Intermountain may in its sole discretion accept alternate forms. However, Intermountain's acceptance of an alternate form in one instance does not waive or modify the requirements herein for subsequent submissions.

11.6 Governing Law, Jurisdiction and Venue. To the maximum extent permitted by law, Utah laws, excluding its conflict-of-law provisions, govern the Contract and both Intermountain and Contractor submit to the exclusive jurisdiction and venue of state and federal courts located in Salt Lake County, Utah.

11.7 Interpretation. In the interest of brevity, the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an", but the fact that a modification or an article is absent from the statement and appears in another is not intended to affect the interpretation of either statement.

11.8 Severability. The invalidity of any part, paragraph, subparagraph, phase, provision or aspect of the Contract documents will not impair or affect in any manner the validity, enforceability or effect of the remainder of the Contract Documents.

11.9 Construction of Words. Unless otherwise stated in the Contract Documents, words, which have well-known technical or construction industry meanings, will be construed as having such recognized meanings. Unless the context requires otherwise, all other technical words will be construed in accordance with the meaning normally established by the particular, applicable profession or industry. All other words, unless the context requires otherwise, will be construed with an ordinary, plain meaning.

11.10 No Third-Party Rights. The Contract Documents will not be construed to create a contractual relationship of any kind (1) between A/E and Contractor, (2) between Intermountain and a Subcontractor or (3) between any persons or entities other than Intermountain and Contractor. Nothing contained herein will be deemed as creating third party beneficiary contract rights or other actionable rights or duties as between Contractor and A/E, or as between Intermountain, Contractor, or A/E on the one hand, and any other person or entity.

11.11 Change of Control. If a third party acquires a controlling interest (i.e., 50% ownership or more) of Contractor, then (a) Contractor will notify Intermountain within fifteen (15) Days of that acquisition, and (b) upon that acquisition, Intermountain may terminate for cause the Contract immediately upon written notice to Contractor.

11.12 Entire Agreement and Amendment Limitation. The Contract represents the entire and integrated agreement between Intermountain and Contractor and supersedes all prior negotiations, representations or agreements, either written or oral. The Contract may be amended or modified only by (1) a written amendment executed by both Intermountain and Contractor, or (2) by a Modification.

11.13 Notices. Any notice required by the Contract will be served upon the recipient's designated representative by hand delivery at the last known business address, or by mail or nationally recognized overnight courier service with "delivery confirmation" to the last known address.

11.14 No Publicity. Without receiving prior written approval from an Intermountain vice president, Contractor will not distribute any publicity regarding the Contract.

11.15 Waivers. No waiver by Intermountain or Contractor of any default will constitute a waiver of the same default at a later time or of a different default.

11.16 Waiver of Consequential Damages. Intermountain and Contractor waive all claims against each other for any consequential damages that may arise out of or relate to the Contract. Intermountain waives damages including but not limited to is loss of use of the Project, any rental expenses incurred, loss of income, profit, or financing related to the Project, loss of business, the services of employees, or loss of reputation. Contractor waives damages including but not limited to the loss of business, loss of financing, principal office overhead and expenses, loss of profits not related to this Project, loss of bonding capacity or loss of reputation. This section may not be construed to preclude recovery of consequential damages when such damages are actually recovered from insurance policies required by the Contract Documents. The provisions of this section also apply to the termination of the Contract and survive such termination.

11.17 Compliance.

11.17.1 Remuneration. Remuneration flowing between the parties is at fair market value for actual and necessary items furnished or services rendered, is based upon an arm's-length transaction, and does not take into account, directly or indirectly, the value or volume of any past or future referral or other business generated between the parties (or of any referral or business of any principal, affiliate, or immediate family member - as those terms may be defined by applicable laws - of either party).

11.17.2 Financial Relationships. To its knowledge, Contractor (a) is not a physician-owned entity and (b) has no prohibited financial relationship with any physician who is in a position to generate business for Intermountain, or with an immediate family member of that physician. Intermountain defines a "physician-owned entity" as any entity in which a physician, or immediate family member of a physician, holds an ownership, investment, or royalty interest (if royalties are paid on any purchase resulting from the royalty holder's order). The Code of Federal Regulations (CFR) defines "financial relationship" (in 42 CFR 411.354) and "immediate family member" (in 42 CFR 411.351).

[Note: Physicians and their immediate family members may own investment securities of Contractor if that investment complies with 42 CFR 411.356(a) or (b), and may have a compensation arrangement that both complies with 42 CFR 411.357(p) and does not take into account the volume or value of referrals or other business generated for Intermountain by a physician or a physician's immediate family members.]

11.17.3 Exclusion or Sanction. Contractor warrants that neither it, or any of its affiliates or employees, excluded from participation in, or sanctioned under, any state or federal healthcare program, including those set forth in 42 U.S.C. §1320a 7b(f). Contractor will notify Intermountain immediately in writing if the warranty in the preceding sentence is, or becomes, inaccurate during the Term.

11.17.4 Access to Books and Records. Intermountain is a provider under Federal Medicare programs and is subject to Section 952 of the Omnibus Reconciliation Act of 1980. That law requires Intermountain, as a provider, to include the following provision in its agreements with suppliers who receive $10,000 or more under an agreement with Intermountain. If requested by the Secretary of HHS, by the U.S. Comptroller, or by an authorized representative of either of them, Contractor will make available to the requestor the Contract and Contractor's books, documents, and records to allow the requestor to certify the nature and extent of the charges for services provided under the Contract and charged to Medicare. Contractor will continue to make those items available for four years after Contractor

furnishes the final products (or services) under the Contract. If Contractor contracts with another to carry out any of Contractor's duties under the Contract and the Subcontractor is to receive $10,000 or more in value under that subcontract, then Contractor will obtain a written contractual commitment from the Subcontractor to comply with the obligations of this section of the Agreement. The obligations of this Section survive the expiration or other termination of the Contract.

11.17.5 Code of Ethics. In its dealings with Intermountain, Contractor has and will comply with all codes of ethics applicable to suppliers and their interactions with purchasers like Intermountain, including, without limitation, the AdvaMed Code of Ethics on Interactions with Health Care Professionals.

11.17.6 Facility Access Policy. All of Contractor's representative(s) entering any Intermountain facility must comply with Intermountain's Facility Access Policy. This policy requires each of these Contractor representatives to check in with Intermountain on each visit to an Intermountain facility to receive an identification badge; and as applicable, log onto: https://intermountainhealthcare.org/supply-chain-organization/for-suppliers/for-current-suppliers/access-to-intermountain-facilities/ and complete the registration requirements. Please contact Intermountain representative with any questions.

11.17.7 Equal Opportunity. Affirmative Action. Intermountain is an equal opportunity employer and federal contractor. Consequently, the parties agree that, to the extent applicable, they will comply with the following, which are incorporated herein by reference: 41 CFR 60 1.4(a), 41 CFR 60 300.5(a), 41 CFR 60 741.5(a), and Executive Order 13496 (29 CFR Part 471, Appendix A to Subpart A), relating to the notice of employee rights under federal labor laws, specifically:

a. Intermountain and Contractor will abide by the requirements of 41 CFR 60 300.5(a), as applicable. This regulation prohibits discrimination against qualified protected veterans, and requires affirmative action by covered prime contractors and Subcontractors to employ and advance in employment qualified protected veterans.

b. Intermountain and Contractor will abide by the requirements of 41 CFR 60 741.5(a), as applicable. This regulation prohibits discrimination against qualified individuals on the basis of disability, and requires affirmative action by covered prime contractors and Subcontractors to employ and advance in employment qualified individuals with disabilities.

11.17.8 Remedies. If Contractor breaches any obligation of this section, Intermountain may immediately terminate for cause the Contract upon written notice to Contractor.

11.18 Work Restrictions / Drug Testing. Contractor will ensure that Contractor, its agents, employees, and all Subcontractors do not use or consume alcohol or cannabis, or illegally use drugs, upon Intermountain's property or enter upon or perform any work on Intermountain's property while under their influence. Contractor will obtain necessary consents and will conduct periodic inspections and drug testing to monitor and ensure compliance with these requirements. Contractor will bear the expenses of such inspections and drug testing and will hold Intermountain harmless from all claims arising out of or relative thereto. In addition, Contractor will ensure that Contractor and all Subcontractors do not smoke or vape anything upon Intermountain's property except and only within designated smoking areas approved by Intermountain.

11.19 Utah State Sales Tax. Contractors should be exempt on purchases of material installed or converted into real property to be used by Intermountain. The Contractor will furnish each vendor with Intermountain's Tax exemption number.

11.20 Notice of Intent to Obtain Final Completion. Contractor shall file with the Utah State Construction Registry, on its own behalf and/or on behalf of Intermountain, a notice of intent to obtain final completion at least forty-five (45) Days before the day on which Intermountain or Contractor files or could file a notice of completion under Utah statutes if: (1) the completion of performance time under the original contract for construction work is greater than one hundred twenty (120) Days; (2) the total

original construction contract price exceeds $500,000; and (3) neither Contractor nor Intermountain has obtained a payment bond in accordance with Utah Code Ann. Section 14-2-1.

11.21 Notice of Completion. Within five (5) Days of final completion of the Project and in compliance with Section 38-1a-507 Utah Code Annotated, Contractor shall file with the Utah State Construction Registry, and copy to Intermountain, a notice of completion which shall include, without limitation, the following:

a. The name, address, telephone number, and email address of the person filing the notice of completion;

b. The name of the county in which the Project and/or Project site is located;

c. The date on which final completion is alleged to have occurred;

d. The method used to determine final completion; and

e. One of the following:
    1. The tax parcel identification number of each parcel included in the Project and/or Project site;
    2. The entry number of a preliminary notice on the same project that includes the tax parcel identification number of each parcel included in the Project and/or Project site; or
    3. The entry number of the building permit issued for the Project.

Notwithstanding any other provision of the Contract Documents to the contrary, Contractor and Intermountain agree that any breach or failure to comply with this requirement by Contractor will constitute a breach of contract and the Contractor will be liable for any direct, indirect, or consequential damages to Intermountain flowing from this breach.

11.22 Audit Rights. Contractor will keep, maintain and preserve complete, current and accurate books, records, and accounts of the transactions contemplated by this Agreement and such additional books, records and accounts as are necessary to establish and verify Contractor's compliance with the Contract. All these books, records and accounts will be available for inspection and audit by Intermountain and/or an independent third party designated by Intermountain and approved by Contractor at any time during the Term and for two (2) years thereafter, but only during reasonable business hours and upon reasonable notice. In addition:

a. Intermountain agrees that its routine audits will not be conducted more frequently than once in any consecutive twelve (12) month period.

b. If, after any audit of Contractor, Intermountain requires additional information regarding the transactions contemplated by the Contract, Contractor will furnish to Intermountain or to the third-party audit firm any additional information Intermountain specifies that relates to the audit period to establish and verify Contractor's compliance with the Contract Documents.

c. Intermountain's right to inspect and audit is without prejudice to any other or additional rights or remedies of either party.

d. Contractor agrees to not unreasonably withhold approval of any independent third-party audit firm.

e. If an audit reveals an overcharge incurred by Intermountain on this Project, Contractor will provide a written response explanation, correct any error and remit any monies due within ten (10) Days after receiving notice of the error or overcharge.

Intermountain may audit applications for payments or any other aspect of the Services and Work of Contractor and of the Subcontractor or suppliers at any tier. Contractor will cooperate with Intermountain in providing all necessary information for any Intermountain audit.

12. TERMINATION OR SUSPENSION OF THE CONTRACT.

12.1 Termination by Contractor.

12.1.1 In General. If the Work is stopped for a period of ninety (90) Days through no act or fault of Contractor or a Subcontractor, or their agents or employees or any other persons performing portions of the Work under contract with any of the above, Contractor, may terminate the Contract in accordance with 12.1.2 herein below for any of the following reasons:

a. Because Intermountain has persistently failed to fulfill fundamental Intermountain's obligations under the Contract Documents with respect to matters important to the progress of the Work;

b. Issuance of an order of a court or other public authority having jurisdiction which necessitates such termination, except that where Contractor has standing, Contractor must cooperate in efforts to stay and/or appeal such order;

c. A governmental declaration of national emergency, making material unavailable; or

d. Unavoidable casualties or other similar causes as listed in Paragraph 12.2.2(2) herein below.

12.1.2 Notice. If one of the reasons for termination in Paragraph 12.1.1 hereinabove exist, Contractor may, upon ten (10) additional Days' written notice to Intermountain and A/E, and such condition giving cause for termination still not cured, terminate the Contract and recover from Intermountain payment for Work executed and for proven loss with respect to materials, equipment, tools, and construction equipment and machinery, including reasonable overhead, profit and damages associated only with work completed before the notice of termination.

12.2 Termination by Intermountain for Cause.

12.2.1 In General. Intermountain may terminate the Contract if Contractor fails to cure any of the following within a period of ten (10) Days (or longer if Intermountain so approves in writing) after receipt of notice from Intermountain specifying the cause for termination:

a. Contractor refuses or fails to supply enough properly skilled workers or proper materials;

b. Contractor fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between Contractor and the Subcontractors;

c. Contractor disregards laws, ordinances, or rules, regulations, resolutions or orders of a public authority having jurisdiction; or

d. Contractor fails to perform the Work within the time specified in the Contract Documents or any authorized extension thereof or Contractor fails to make progress with the Work as to endanger such compliance;

e. Contractor fails to perform the Work or is otherwise in breach of a provision of the Contract Documents;

f. Contractor fails to respond promptly to the financial responsibility inquiry herein;

g. As permissible by law for a reason to terminate, Contractor is adjudged bankrupt;

h. As permissible by law for a reason to terminate, Contractor should make a general assignment for the benefit to creditors;

i. As permissible by law for a reason to terminate, Contractor has or should have a receiver appointed on account of Contractor's insolvency; or

j. Contractor fails to follow the material safety requirements and precautions either as expressly provided in the Contract Documents or as consistent with the customary practices in the industry.

12.2.2 Intermountain's Right to Carry Out the Work. If Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten (10) Day period (or longer if approved by Intermountain in writing) after receipt of written notice from Intermountain to cure such default or neglect, Intermountain may without prejudice to other remedies Intermountain may have, correct such deficiencies, including taking over the Work and prosecuting the same to completion, by contract or otherwise, and may take possession of, and utilize in completing the Work, such materials, appliances, and facilities as may be on the site of the Work as well as the site as necessary for its proper completion. In such case, Intermountain will offset from payments then or thereafter due Contractor the cost of correcting such deficiencies, including compensation for A/E, Intermountain's staff and legal counsel's additional services and expenses made necessary by such default, neglect or failure. If payments then or thereafter due Contractor are not sufficient to cover such amounts, Contractor will pay the difference to Intermountain. Contractor will continue performance of the Contract to the extent not terminated.

12.2.3 Items Required to Be Transferred or Delivered. Intermountain may require Contractor to transfer title and deliver to Intermountain, in the manner and to the extent directed by Intermountain:

a. Any completed portion of the Work; and

b. Any partially completed portion of the Work and any parts, tools, dies, jigs, fixtures, drawings, information, and contract rights (hereinafter called "construction materials") as Contractor has specifically produced or specifically acquired for the performance of such part of this Contract as has been terminated; and Contractor will, upon direction of Intermountain, protect and preserve property in the possession of Contractor in which Intermountain has an interest.

12.2.4 Payment. When Intermountain terminates the Contract for one or more of the reasons stated in Paragraph 12.2.1, Intermountain may withhold payment and/or pursue all available remedies.

12.2.5 Intermountain Protection If Lienable. When the subject property is lienable, Intermountain may withhold from amounts otherwise due Contractor for such completed Work or construction materials such sum as Intermountain determines to be necessary to protect Intermountain against loss because of outstanding liens or claims for former lien holders.

12.2.6 Credits and Deficits. If the unpaid balance of the Contract Sum exceeds the full cost of finishing the Work, including compensation for A/E's services and expenses made necessary thereby, such excess will be paid to Contractor. If such cost exceeds the unpaid balance, Contractor will pay the difference to Intermountain this obligation for payment will survive the termination of the Contract.

12.2.7 If Contractor Found Not in Default or Excusable**.** If, after notice of termination of the Contract under the provisions of this Article, it is determined for any reason that Contractor was not in default under the provisions of this Article, or that the default was excusable under the provisions of this Article, the rights and obligations of the parties will be the same as if the notice of termination had been issued pursuant to the termination for convenience provisions.

12.2.8 Rights and Remedies Not Exclusive. The rights and remedies of Intermountain provided in this Article 12.2 will not be exclusive and are in addition to any other rights and remedies provided by law or under this Contract.

12.3 Suspension, Delay or Interruption of Work by Intermountain for Convenience.

12.3.1 By Intermountain in Writing. Intermountain may in writing and without cause, order Contractor to suspend, delay or interrupt the Work in whole or in part for such period of time as Intermountain may determine to be appropriate for the convenience of Intermountain.

12.3.2 Adjustments. Any adjustment in Contract Sum and Contract Time will be in accordance with Articles 3, 4, and 7.

12.4 Termination for Convenience of Intermountain.

12.4.1 In General. The performance of Work under this Contract may be terminated by Intermountain in accordance with this Article 12.4 in whole, or from time to time, in part, whenever Intermountain will determine that such termination is in the best interest of Intermountain or any person for whom Intermountain is acting under this Contract. Any such termination will be effected by delivery to Contractor of a notice of termination specifying the extent to which performance of Work under the Contract is terminated, and the date upon which such termination becomes effective.

12.4.2 Contractor Obligations. After receipt of a notice of termination, and except as otherwise directed by Intermountain in writing, Contractor will:

a. Stop work under the Contract on the date and to the extent specified in the notice of termination;

b. Place no further orders or subcontracts for materials, services or facilities, except as may be necessary for completion of such portion of the Work under the Contract as is not terminated;

c. Terminate all orders and subcontracts to the extent that they relate to performance of Work terminated by the notice of termination;

d. Assign to Intermountain in the manner, at the times, and to the extent directed by Intermountain, all of the right, title and interest of Contractor under the orders and subcontracts so terminated, in which case Intermountain will have the right, in its discretion, to settle or pay any or all claims arising out of the termination of such orders and subcontracts;

e. Settle all outstanding liabilities and all claims arising out of such termination of orders and subcontracts, with the approval or ratification of Intermountain, which approval or ratification will be final for all the purposes of this Article 12.4;

f. Transfer title and deliver to Intermountain in the manner, at the times, and to the extent, if any, directed by Intermountain:

(i) The fabricated or unfabricated parts, work in process, completed work, supplies, and other material produced as a part of, or acquired in connection with the performance of the Work terminated by the notice of termination; and

(ii) The completed or partially completed drawings, information, and other property which, if the Contract had been completed, would have been required to be furnished to Intermountain;

g. Use best efforts to sell, in the manner, at the times, to the extent, and at the price or prices directed or authorized by Intermountain, any property of the types referred to in Paragraph 12.4.2.f above; provided, however, that Contractor:

(i) Will not be required to extend credit to any purchaser; and

(ii) May acquire any such property under the conditions prescribed by and at a price or prices approved by Intermountain; and provided further that the proceeds of any such transfer of or disposition will be applied in reduction of any payments to be made by Intermountain to Contractor under this Contract or will otherwise be credited to the Contract Sum or paid in such other manner as Intermountain may direct;

h. Complete performance of such part of the Work as will not have been terminated by the notice of termination; and

i. Take such action as may be necessary, or as Intermountain may direct, for the protection and preservation of the property related to this Contract which is in the possession of Contractor in which Intermountain has or may acquire an interest.

12.4.3 Agreed Upon Payment. Subject to the provisions of Paragraph 12.4.2 above, Contractor and Intermountain may agree upon the amount to be paid to Contractor by reason of the total or partial termination of Work pursuant to this Article 12.4.

12.4.4 Payment Not Agreed Upon. In the event of the failure of Contractor and Intermountain to agree, as provided in Paragraph 12.4.3, upon the whole amount to be paid to Contractor by reason of the termination of Work pursuant to this Article 12.4, Intermountain will pay to Contractor the portion of the Contract Sum requisite with the portion of the Work completed as determined by Intermountain as of the date of termination, subject to offsets if any.

12.4.5 Deductions. In arriving at the amount due Contractor under this Article 12.4, there will be deducted:

a. All unliquidated advance or other payments on account theretofore made to Contractor, applicable to the terminated portion of this Contract;

b. Any Claim which Intermountain may have against Contractor in connection with this Contract; and

c. The agreed price for, or the proceeds of sale of, any materials, supplies, or other things acquired by Contractor or sold, pursuant to the provisions of this Article 12.4, and not otherwise recovered by or credited to Intermountain.

12.4.6 Partial Payments. Intermountain may, from time to time, under such terms and conditions as it may prescribe, make partial payments and payments on account against cost incurred by Contractor in connection with the terminated portion of this Contract whenever, in the opinion of Intermountain the aggregate of such payments will be within the amount to which Contractor will be entitled hereunder. If the total of such payments is in excess of the amount finally agreed or determined to be due under this Article 12.4, such excess will be payable by Contractor to Intermountain upon demand, together with interest at a rate of five percent (5%) per annum for the period until the date such excess is repaid to Intermountain; provided, however, that no interest will be charged with respect to any such excess payment attributable to a reduction in Contractor's claim by reason of retention or other disposition of termination inventory until ten (10) Days after the date of such retention or disposition, or such later date as determined by Intermountain by reason of the circumstances.

12.4.7 Preserve and Make Available Records. Unless otherwise provided for in this Contract, or by applicable law, Contractor will, from the effective date of termination until the expiration of three years after final settlement under this Contract, preserve and make available to Intermountain at all reasonable times at the office of Contractor, but without direct charge to Intermountain, all books, records, documents and other evidence bearing on the costs and expenses of Contractor under this Contract and relating to the Work terminated hereunder, or, to the extent approved by Intermountain Representative, photographs, micrographs, or other authentic reproductions thereof.

12.4.8 Intermountain's Right to Stop the Work. If Contractor fails to correct Work or fails to carry out Work, as required by the Contract Documents or fails to comply with all required and customary safety precautions; Intermountain, by written order signed personally or by an agent specifically so empowered by Intermountain in writing, may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of Intermountain to stop the Work will not give rise to a duty on the part of Intermountain to exercise this right for the benefit of Contractor or any other person or entity.

END OF DOCUMENT

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Work covered by the Contract Documents.
2. Use of premises.
3. Code compliance
4. Dust control
5. Protection of existing improvements
6. Traffic Control
7. Temporary Controls

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Identification: Project includes infill of existing shelled space on the second floor of the Alta View Clinic to create a space for ENT and General Surgery clinics with exam, procedure, care team, audio booth with VNG exam, and associated support areas including offices and processing room as outlined in the construction documents.

B. Total square feet: 4,350 SF.

Project Location: Alta View Clinic, Level 2
Address: 9450 South, 1300 East, Sandy, UT 84094

C. 1. Owner: Intermountain Healthcare, 36 South State Street, 23rd Floor
Salt Lake City, Utah 84111

2. Owner's Representative: Jennifer Paul, Construction Project Manager

D. Architect: NJRA Architects, 5272 College Drive, Suite 104, Murray, Utah 84123.

E. The Work consists of the following:

1. The Work includes: architectural, structural, mechanical, plumbing and electrical work as defined on the contract documents.

1.4 USE OF PREMISES

A. Contractor's use of premises is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

B. Assume full responsibility for the protection and safekeeping of products under this Contract, stored on the site.

1.5 CODE COMPLIANCE

A. All work shall comply with current edition of codes including but not limited to the following:

1. International Building Code
2. International Mechanical Code
3. International Plumbing Code
4. NFPA
5. National Electric Code
6. OSHA Regulation
7. Health and Safety Regulations
8. Utility Company Regulations
9. Police, Fire Department Rules
10. Environmental Protection Regulations
11. Americans with Disabilities Act

B. Arrange for authorities having jurisdiction to inspect and test according to their requirements and for each temporary utility before use. Obtain required certifications and permits.

C. Requirements of codes and regulations shall be considered as the minimum. Where the contract documents exceed (without violating) code and regulation requirements, contract requirements shall take precedence. Where codes conflict, the more stringent shall apply.

1.6 DUST CONTROL

Temporary partitions should be constructed as called out on the Contract Documents and as mentioned in specification Section 024119 – Selective Demolition.

1.7 PROTECTION OF EXISTING IMPROVEMENTS

A. Take precautions necessary to protect all existing utilities, monitor wells, and other Site improvements to remain from damage due to the work of this Project.

B. Provide restoration of damaged property if damage is a result of construction activities.

1.8 TRAFFIC CONTROL

A. Maintain control of vehicular and pedestrian traffic caused by, or resulting from, the work of this Project.

B. Means of control shall be in accordance with the applicable regulations of the jurisdiction responsible for traffic safety.

1.9 TEMPORARY CONTROLS

A. Conform to all applicable state and local ordinances and regulations. Obtain and pay for necessary permits and licenses as required by local jurisdictions.

END OF SECTION

SECTION 012900 – PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes measurement and payment provisions for, but not limited to, the following:

1. Materials Delivered but Not Yet Installed.

2. Schedule of Values.

3. Applications for Payment.

4. Preliminary Progress Schedule.

5. Construction Progress Schedule.

6. Change Orders.

1.2 MATERIALS DELIVERED BUT NOT INSTALLED

A. Exclude from Applications for Payment materials or equipment delivered and stored, but not yet incorporated into the Work, unless circumstances dictate acceptance (i.e. pre-purchase of equipment for early delivery to prevent delay of construction or subsequent facility opening date) and pre-payment is agreed to, in writing, by the Owner.

B. If Owner has agreed to make early payment on account of materials or equipment not incorporated in the Work, but delivered and stored in conformance with the requirements of the Contract Documents, at the site, or at some other location agreed upon in writing, such pre-payment shall be conditioned upon approval by Contractor's Insurance Carrier, and Architect, in writing, prior to submission by Contractor of the applicable payment request.

C. Pre-payment request shall contain substantiating documentation, including:

1. Bill(s) of Sale.

2. Evidence of insurance for the materials or equipment, covering the item(s) until completion of installation.

3. Provision for transportation to the Project Site.

4. Protection of Owner's interest under any circumstance (i.e. Owner's right to retrieve equipment or materials from storage area of a bankrupt company's property).

5. Provision for inspection/testing at the stored location.

6. Provision for security until completion of installation.

1.3 SCHEDULE OF VALUES

A. Type schedule on Intermountain standard form. Owner's Standard Invoice/Schedule of Values or Contractor's standard forms and automated printout equivalent to the IH standard form will be considered for approval by Owner upon Contractor's request. Identify schedule with:

1. Title of Project and location.

2. Architect and Project number.

3. Name and Address of Contractor.

4. Contract designation.

5. Date of submission.

B. Schedule shall list the installed dollar value of the component parts of the Work in sufficient detail to serve as a basis for computing values for progress payments during construction.

C. List each subcontract first using the Table of Contents of the Project Manual as the format.

1. Next list any allowances included in the contract amount.

2. List each major section or portion of work to be performed by the Contractor.

3. List Contractor's fee separately.

4. List any contingencies.

5. Identify each line item with the number and title of the respective major section of the specifications.

6. Subdivide items to correspond with cost correlation requirements for construction progress schedule.

D. For each major line item list sub-values of major products by building area or floor level or other operations under the item.

E. For the various portions of the Work:

1. Each item shall include a directly proportional amount of the Contractor's overhead and profit.

2. For items on which progress payments will be requested for stored materials, break down the value into:

a. The cost of the materials, delivered and unloaded, with taxes paid.

b. The total installed value.

B. The sum of all values listed in the schedule shall equal the total Contract Sum.

C. Refer to General Conditions, Article 12, for changes.

1.4 APPLICATIONS FOR PAYMENT

A. Format and Data Required:

1. Submit applications typed on Intermountain Healthcare Application and Certification for Payment form.

2. Submit via email and confirm with owner number of copies with "wet" signatures.

3. Add provision for Inspector of Record's signature.

B. Provide itemized data on continuation sheet:

1. Format, schedules, line items and values: Those of the Schedule of Values accepted by Architect.

2. Include Payment Application number.

C. Preparation of Application for Each Progress Payment:

1. Application Form:

a. Fill in required information, including that for Change Orders executed prior to date of submittal of application along with the number assigned to each Change Order.

b. Fill in summary of dollar values to agree with respective totals indicated on continuation sheets.

c. Certification that the Project Record Documents are current with the progress status of the Project.

d. Execute certification with signature of a responsible officer of Contract firm.

2. Continuation Sheets:

a. Fill in total list of all scheduled component items of Work, with item number and scheduled dollar value for each item.

b. Fill in dollar value in each column for each scheduled line item when work has been performed or products stored.

1) Round off values to nearest dollar, or as specified for Schedule of Values, and percent of item completion.

c. List each Change Order executed prior to date of submission, at the end of the continuation sheets.

1) List by Change Order number, and description, as for an original component item of work.

D. Substantiating Data for Progress Payments:

1. When Owner or Architect requires substantiating data, submit information, with a cover letter identifying:

a. Project.

b. Application number and date.

c. Detailed list of enclosures.

d. For stored products.

1) Item number and identification as shown on application.

2) Description of specific Material.

2. Submit 1 copy of data and cover letter for each copy of application.

3. Revised updated CPM schedule.

4. Current period's General Contractor Conditional Waiver and the prior period's Unconditional Waiver.

5. Waivers from Subcontractors.

6. Copies of invoices for National Purchase Agreement (NPA) items.

7. Corrections and updates to "as-built" documents.

E. Preparation of Application for Final Payment:

1. Fill in application form as specified for progress payments.

2. Use continuation sheet for presenting the final statement of accounting as specified in Section 01700 - CONTRACT CLOSEOUT.

F. Submittal Procedure:

1. Submit Applications for Payment to Owner at the times stipulated in the Agreement.

2. Number: Copies of each Application as requested by owner and minimum 1 hard copy of any color brochure/samples.

3. When Owner, Inspector of Record, and Contractor agree on percentages to be requested, and when agreed and signed by them and Architect, Architect will transmit the Certificate for Payment to Owner.

4. Approval and signing of the Application for Payment by Owner and Architect is contingent upon approval of the current status of the As-Built Drawings/Record Documents and submittal of updated CPM schedule.

1.5 CHANGE ORDERS

A. Change Orders shall be processed by the Architect in accordance with the Conditions of the Contract, Supplementary Conditions of the Contract, and as herein specified.

B. Coordination with Contractor's Submittals:

1. Revise Schedule of Values and Application for Payment forms monthly to record each change as a separate item of Work, and to record the adjusted Contract Sum.

2. Upon completion of work under a Change Order, enter pertinent changes in record documents.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 013100 – PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section describes the requirements for Project coordination.

1.2 DESCRIPTION OF REQUIREMENTS

A. Minimum administrative and supervisory requirements necessary for coordination of Work shall be fulfilled collectively by the Contractor in coordination with subcontractors including, but not necessarily limited to, the following:

1. Coordination drawings.

2. Coordination meetings.

3. Administrative coordinating personnel.

4. Contractor's coordination of work.

1.3 COORDINATION MEETINGS

A. Schedule and conduct meetings and conferences at project site, unless otherwise indicated.

1.4 ADMINISTRATIVE COORDINATION PERSONNEL

A. Provide a General Superintendent and other administrative and supervisory personnel required for performance of the Work.

B. Provide specific coordinating personnel for each subcontractor as reasonably required for interfacing Work with other work of total Project.

C. Submittal of Staff Names, Duties: Within 7 days of Notice to Proceed submit to the Owner a listing of principal staff assignments and consultants, including names, addresses and telephone numbers.

1.5 CONTRACTOR'S COORDINATION OF WORK

A. Provide and coordinate the following:

1. General and special services and operations to furnish and install Work.

2. Primary, major and accessory materials, and items necessary to complete the installation.

3. Labor operations and material items reasonably incidental for finishing.

4. Performance of work and delivery of materials in accordance with established construction schedules.

B. Coordinate all aspects of construction operations, generally, and specifically as required to provide Owner with a complete, operable facility.

1. Resolve any dispute over coordination, or failure to coordinate, such that resolution is consistent with Contract Documents. When such resolution is not possible, refer to the General Conditions.

2. Where proper execution of this Work depends on the work of any other contractor, inspect and promptly report to Architect any defects in such work that render it unsuitable for such proper execution and results.

3. Cooperate with other contractors on the Project site and with Architect so that completion of all work can proceed with prudent speed.

a. Furnish other contractors, whose work is fitted to this work, detail and erection drawings giving full information regarding the fabrication and assembly of this Work.

b. So far as possible, drawings shall indicate checked field measurements.

c. Cooperate in timing this Work to join with the work of other contractors or the Owner.

4. Check the drawings of other contracts for interferences with this Work and promptly report to Architect, in writing, any such interferences.

5. Submit complete information, including Drawings, descriptions, sketches, marked prints, etc., as required for Architect's review and coordination of drawings by others which are a part of this Work.

C. Mechanical, Electrical, and Related Systems Coordination: Prior to proceeding with the work, and before installation, coordinate and work out all "tight" conditions involving work of various Sections.

1. Before work proceeds in these areas, prepare supplemental drawings for review by the Architect.

2. Provide all work necessary to coordinate tight conditions, including supplemental drawings in sufficient detail for showing that all work is coordinated in "tight" areas, and additional labor and materials necessary to overcome "tight" conditions at no increase in cost to the Owner.

3. Coordination of "tight" conditions shall include:

a. Providing sufficient clear space around all equipment necessary for maintenance access and as required by Code.

b. Adjustments in depth, position, and elevation of underground and overhead utilities at points of conflict. Utility space conflicts shall be resolved by giving precedence to those utilities which are called out to be sloped. The term "utility" as used in this paragraph includes: all piping, conduit, and ductwork.

1.6 COORDINATION DRAWINGS

A. Submit plans and cross-sections in sufficient detail to show coordinated layout of all ducts, pipes, electrical work, access doors, above ceiling clearances, canopy rigging, acoustical curtains, and other related items. Plans and cross-sections shall be provided that include all underground ducts, electrical ductbanks, piping, and other underground utilities.

B. Engage professional drafter to prepare these drawings to one-quarter scale on Auto-CAD with title blocks to match the Contract Drawings.

1. These plans shall reflect existing dimensions as field-verified by the Contractor.

2. Plans shall be uniform and identical and shall serve as backgrounds for preparation of shop or layout drawings required under Divisions 15 and 16 and ultimately for recording of as-built information required under these divisions.

3. Where additional sheets of elevations, sections, details, and/or diagrams are required, such sheets shall match the Contract Drawings with respect to size and title block.

4. Prior to beginning excavation for structural footings and utilities, submit a coordination plan showing all underground utilities including: all underground piping, underground ductwork, electrical and communication ductbanks.

a. The plan shall be a composite overlay of sheets each dedicated to a single underground utility using a common background and scale.

b. Dimensions shall be sufficient to clearly indicate the position and depth of each utility relative to structural footings, above grade structures, and finished grade.

c. At points where the plan indicates that utilities will cross each other, cross a structural footing, or run within six (6) feet parallel to either each other or a structural footing, provide a cross section drawing.

d. Cross section drawings shall clearly show the relative positions and depths of each utility and structural footing.

e. The composite plan and cross section drawing(s) shall be updated to "as-builts" and submitted with the Project Record (As-Built) Drawings.

C. Do not commence work until the Architect has reviewed these Drawings.

1.7 MISCELLANEOUS PROVISIONS

A. Prior to starting a particular type or kind of work:

1. Examine for relevant information, all Contract Documents and subsequent data issued;

2. Check accepted submittals and verify dimensions at job site;

3. Consult manufacturers for instructions applicable to conditions under which Work is to be installed;
4. Inspect areas, surfaces or construction receiving the Work.

a. Start of work shall signify compliance with the above requirements and acceptance of previously placed construction or substrates as being in satisfactory condition to achieve proper installations and first quality workmanship as intended under these specifications.

b. Failure to so inspect and report shall constitute an acceptance of the other contractor's work.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 013110 – FIELD ENGINEERING

PART 1 - GENERAL

1.1 FIELD MEASUREMENTS AND EXISTING CONDITIONS

A. Contractor Responsibility: Exact field measurements are responsibility of the Contractor. Any required off-sets, additional fittings, re-routing of existing or new work to provide serviceable system within the location shown, and to maintain head room and clearances to match existing construction, are responsibility of the Contractor.

B. Layout of the Work: The Contractor shall employ, at the Contractor's own expense, Registered Civil Engineer or Licensed Land Surveyor. Contractor's engineer or surveyor will provide layout of the work of the Project and establish all reference points and elevations required for construction.

1.2 GRADES, LINES AND LEVELS

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

C. Benchmarks: Establish and maintain a minimum of six permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.

3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Preservation: All stakes, boundary lines, bench marks or survey marks, etc., which have been or may be established in any part of the Project site or adjacent thereto shall be carefully preserved and respected by the Contractor and shall be restored at the Contractor's expense if lost or destroyed as result of the Contractor's operations.

1. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

E. Conflict: The Contractor will be held responsible for correctness of layout, for

establishing location of existing concealed utility lines, and for notifying the Architect in writing in event of conflict with the Drawings. In such case, the Contractor shall not proceed until instructed by the Architect.

F. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, plumbness and elevations of construction and sitework.

G. Final Property Survey: Prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.

END OF SECTION

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

1.3 SUBMITTAL PROCEDURES

A. General: Electronic copies of CAD Drawings of the Contract Drawings will not be provided by Architect for Contractor's use in preparing submittals.

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

C. Submittals Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities. Submittals should be submitted by contractor to architect **within 30 days from notice to proceed**.

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

1. Initial Review: Allow 10 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Resubmittal Review: Allow 10 days for review of each resubmittal.

E. Identification: Place a permanent label or title block on each submittal for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Include the following information on label for processing and recording action taken:

    a. Project name.
    b. Date.

c. Name and address of Architect.
d. Name and address of Contractor.
e. Name and address of subcontractor.
f. Name and address of supplier.
g. Name of manufacturer.
h. Submittal number or other unique identifier, including revision identifier.
i. Number and title of appropriate Specification Section.
j. Drawing number and detail references, as appropriate.
k. Location(s) where product is to be installed, as appropriate.

F. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form.

G. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities.

1. Use for Construction: Use only final submittals with mark indicating "Approval notation from Architect's action stamp".

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

A. General: Prepare and submit Action Submittals required by individual Specification Sections.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. Mark each copy of each submittal to show which products and options are applicable.
2. Include the following information, as applicable:

a. Manufacturer's written recommendations.
b. Manufacturer's product specifications.
c. Manufacturer's installation instructions.
d. Standard color charts.
e. Manufacturer's catalog cuts.
f. Standard product operation and maintenance manuals.
g. Compliance with specified referenced standards.

3. Submit Product Data concurrent with Samples.
4. Number of Copies: Submit four copies of Product Data, unless otherwise indicated.

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

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

a. Dimensions.
b. Identification of products.
c. Fabrication and installation drawings.
d. Roughing-in and setting diagrams.
e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
f. Shopwork manufacturing instructions.
g. Schedules.
h. Design calculations.
i. Compliance with specified standards.
j. Relationship to adjoining construction clearly indicated.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 30 by 40 inches (750 by 1000 mm).
3. Number of Copies: Submit four opaque copies of each submittal, Architect will retain two copies; remainder will be returned.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

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

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

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

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

3.2 ARCHITECT'S ACTION

A. General: Architect will not review submittals that do not bear Contractor's approval.

B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:

END OF SECTION

SECTION 014000 – QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section describes the requirements for Owner furnished testing and inspection services which include the following:

1. Observation by Inspector of Record.

2. Laboratory responsibilities.

3. Laboratory reports.

4. Limits on testing laboratory authority.

5. Contractor responsibilities.

6. Schedule of inspections and tests.

B. These services are identified to indicate the requirement for cooperation and assistance needed by Owner's testing and inspection agency.

1.2 QUALITY ASSURANCE

A. Testing and Inspection Agency Qualifications: A testing and inspection agency must have a minimum 5 years continuing experience preceding date of these Contract Documents, and be qualified in accordance with the following American Society for Testing and Materials (ASTM) publications:

1. ASTM E 548-84 Standard Practice for Generic Criteria for use in the Evaluation of Testing and Inspection Agencies.

2. ASTM E 699-79 (1984) Standard Criteria for Evaluation of Agencies Involved in Testing, Quality Assurance, and Evaluating Building Components in Accordance with Test Methods Promulgated by ASTM Committee E-6.

B. Testing Equipment: Calibrated at intervals with devices of accuracy traceable to either National Bureau of Standards or accepted values of natural physical constants.

1.3 INSPECTION AND TESTING PERSONNEL AND FACILITIES

A. Inspector of Record:

1. The Owner will employ one or more qualified Inspectors of Record, acceptable to the Local Building Department issuing Permits who will be employed continuously at the construction site, working under the

Owner Representative's general direction. The IOR(s) will observe progress of the work and to report to the Owner any non-conformance with Contract Documents.

2. In compliance with the State Building Code, Part 1, Title 24 of the California Code of Regulations, Article 7-145, the Inspector of Record shall have personal knowledge, obtained by continuous inspection of all parts of the work of construction in all stages of its progress, to ensure that the work is in accordance with the approved contract documents.

3. Specific duties and limits of responsibilities include the following:

   a. Observing and spot checking materials upon arrival at site, and work in progress, to determine conformance with Contract Documents. Reporting any defects immediately to the Owner.

   b. Maintaining liaison with the Contractor and his Subcontractors only through Contractor's superintendent.

   c. Evaluating Contractor's suggestions and reporting them with recommendations to the Owner for final decision.

   d. Remaining alert to the Construction Schedule and immediately reporting any potential delays and problems to the Owner.

   e. Maintaining a Daily Log of activities on site, pertinent to a continuous project report record.

   f. Preparing a Verified Report every 3 months (or sooner if required for a specific project schedule).

   g. Receiving Samples of construction materials at the jobsite.

   h. Scheduling and accompanying regulatory inspectors through the project and reporting to the Owner the results of such inspection visits.

   i. Being alert to conditions which could affect Hospital's existing operation.

   j. Reviewing and verifying degree of work completion with that cited in Contractor's monthly payment request.

   k. Maintaining Contract information and Shop Drawing files.

   l. Preparing a Field Inspection Report of incomplete or unsatisfactory work at intervals throughout the work progress. Checking off such items when made complete and satisfactory by Contractor.

   m. Attending project meetings in accordance with specifications Section 013100.

n. Enforcing Infection Control requirements.

o. Provide all coordination for independent Testing Laboratories.

p. Participate in formation of Final Punch List.

B. Local Permit Issuing Agency will approve the Inspector of Record for the project who shall be allowed access to the project site at any time.

C. Geotechnical Engineer: Observation of all excavations and engineering control of all fills and backfills shall be by a Geotechnical Engineer.

1. Owner will contract with the Geotechnical Engineer for observation and testing of all excavations and engineering control of all fills and backfills.

2. The Geotechnical Engineer shall submit a Final Report verifying that Work has been performed in accordance with the requirements of the Contract Documents and Soils Investigation Report(s) prepared for this Project.

3. The Geotechnical Engineer shall distribute the Final Report in accordance with Paragraph 1.4, B.

D. Testing and Inspection Agency:

1. The Owner will employ and pay for the services of an independent testing and inspection agency to perform the tests and inspections required herein except where noted otherwise.

a. Employment of the testing and inspection agency shall in no way relieve the Contractor's obligation to perform the work defined in the Contract Documents.

2. Limitations of authority of the Testing and Inspection Agency:

a. Testing Agency is not authorized to:

1) Release, revoke, alter, or enlarge on the requirements of the Contract Documents;

2) Approve or accept any portion of the Work, or;

3) Perform any duties of the Contractor.

3. All work shall conform to the requirements of state and local applicable Codes.

4. Testing and inspection agency shall perform tests and inspections as required by applicable regulation as indicated in the specification Sections, and as directed by the Owner and required by the Code.

5. Testing and inspection agency shall prepare, cure, store, and transport job samples to the Laboratory.

6. At the completion of the Project, verified reports shall be submitted as required by CCR, Title 22 and as directed.

1.4 LABORATORY REPORTS

A. After each inspection and test, promptly submit copies of laboratory report which includes:

1. Date issued,

2. Project title and number,

3. Name of Inspector from inspection agency,

4. Date and time of sampling or inspection,

5. Identification of product and specifications section,

6. Location in the Project,

7. Type of inspection or test,

8. Date of test,

9. Results of tests,

10. Conformance with Contract Documents,

11. Whether original test or re-test,

12. State/local permit number,

B. Reports shall be distributed to the following:

1. Architect of Record

2. Inspector of Record (I.O.R.)

3. General Contractor

4. Owner.

5. Applicable Consultant

6. Local Jurisdiction where applicable

1.5 LABORATORY RESPONSIBILITIES

A. Provide qualified personnel at site. Cooperate with Architect/Inspector of Record and Contractor in performance of services.

B. Perform specified inspecting, sampling, and testing of Products in accordance with specified standards.

C. Ascertain compliance of materials and mixes with requirements of Contract Documents.

D. Promptly notify Architect, IOR and Contractor of observed irregularities or non-conformance of Work or Products.

E. Perform additional inspection and test required by Architect.

F. Attend preconstruction meetings and progress meetings when requested.

1.6 CONTRACTOR'S RESPONSIBILITIES

A. Cooperate with Inspector of Record and Testing and Inspection Agency and provide access to Work, including off-site manufacturer's or fabricator's operations.

1. Provide required quantities of material samples to be tested.

2. Samples will be selected and taken by representative of Testing and Inspection Agency.

B. Furnish copies of product data and test reports as required.

C. Furnish incidental labor and facilities:

1. To provide access to work to be tested;

2. To obtain and handle samples at the Project site, or at the source of the Product to be tested or inspected;

3. To facilitate inspections and tests, and;

4. For storage and curing of test samples at the Project site.

D. Provide, on a weekly basis, a Short Interval Project Schedule with a minimum three-week duration which identifies upcoming testing requirements.

E. Schedule the tests and inspections required by the Contract Documents and applicable codes and regulations with the Inspector of Record and the Testing and Inspection Agency, a minimum of 48 hours in advance.

1. When tests or inspections cannot be performed after such notice, or if re-tests and re-inspections are required due to the fault of the Contractor, all costs for such re-work shall be deducted from the Contract Amount. If the remaining unpaid balance in the Contract is

insufficient to cover the Change Order for this work, Contractor shall pay the difference directly to the Owner.

2. Do not cover corrected Work until said Work has been re-tested and or re-inspected satisfactorily.

F. Arrange with Owner's Testing and Inspection Agency and pay for additional samples and tests required for the Contractor's convenience when approved by Owner.

G. Contractor shall pay costs for the following specified items:

1. Design mixes for:

a. Cast-in-Place concrete

b. Asphalt paving

2. Redesign of mixes due to change in source of ingredients.

3. Certified mill test reports.

4. Pre-construction tests for masonry units.

5. Preparation and delivery to laboratory of pre-construction masonry prisms for testing.

H. Notification of Architect:

1. In addition to tests and inspections called for in this Section, notify applicable parties of inspections and testing called for in the individual Sections of the Specifications or on the Drawings.

2. Notify 48 hours in advance, to assure inspections prior to covering up or closing in of work involved. Any work covered up before such required inspection or testing shall be uncovered or removed at the Contractor's expense.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 014339 - MOCKUPS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Build indicated mock-up on site for review and approval before proceeding with any construction that may be affected by construction represented by mock-up.

1.2 PROCEDURE

A. Extent, size, form and primary components are indicated on Drawings or in Specifications.

B. Locate mock-up where indicated on drawings or, if not indicated, locate as directed by Architect.

C. Do not provide mock-up until corresponding product data, shop drawings, samples and other preparatory submittals are approved.

D. Do not provide mock-up until specified Preinstallation Conferences related to mock-up components are held.

E. Mock-up shall be rebuilt as necessary until approved by Architect.

F. Architect's acceptance of mock-up construction and materials will only be considered once mock-up is entirely completed.

G. After approval, mock-up shall remain and serve as the standard for judging acceptance or rejection of the appearance characteristics and workmanship of corresponding construction.

H. After completion and acceptance of the corresponding construction, mock-up shall be removed when directed by Architect unless approved mock-up has been located as part of permanent construction.

I. Surrounding and other construction affected by mock-up construction or removal shall be completed as indicated or, if construction is not indicated, site shall be restored to condition existing before mock-up construction.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials used in initial mock-up construction shall comply as specified in applicable sections for Work and as approved by submittal reviews.

B. Materials may be modified only to the extent required for mock-up approval by Architect.

1. Modified materials shall comply with specified requirements but may differ in appearance characteristics, such as color and texture.

C. Materials used in construction of approved mock-up construction shall be used in corresponding permanent construction.

PART 3 - EXECUTION

3.1 CONSTRUCTION

A. Provide initial mock-up construction by methods proposed for corresponding permanent construction.

1. Comply with installation and application requirements for each component as specified in section applicable for Work.

B. Methods of construction may be modified only to extent required for mock-up approval by Architect.

1. Modified methods of construction shall comply with specified requirements as well as approved details of workmanship.

C. Methods of construction used for approved mock-up construction shall be used in corresponding permanent construction.

1.3 MOCK UP ROOMS:

1. CHAIR 4, ROOM A129

END OF SECTION

SECTION 014373

SCHEDULE OF VALUES

NAME OF BIDDER: _____

DATE:_____

DIV	TITLE	AMOUNT	$/SQ. FT	COMMENTS
01	General Conditions	$_____	$_____	
02	Demolition	$_____	$_____	
02	Saw cut slab	$_____	$_____	
03	Concrete	$_____	$_____	
04	Masonry	$_____	$_____	
05	Steel	$_____	$_____	
06	Woods and Plastics	$_____	$_____	
07	Thermal and Moisture Protection	$_____	$_____	
08	Openings	$_____	$_____	
09	Finishes	$_____	$_____	
10	Specialties	$_____	$_____	
12	Furnishings	$_____	$_____	
21	Fire Suppression	$_____	$_____	
22	Plumbing	$_____	$_____	
23	HVAC	$_____	$_____	
26	Electrical	$_____	$_____	
31	Earthwork	$_____	$_____	
32	Landscape	$_____	$_____	
33	Utilities	$_____	$_____	
	SUBTOTAL	$_____	$_____	
	OVERHEAD AND PROFIT	$_____	$_____	
	TOTAL COST	$_____	$_____	

END OF SECTION

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 USE CHARGES

A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost.

B. Water Service: Pay water service use charges for water used by all entities for construction operations.

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

1.4 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 MATERIALS

2.2 TEMPORARY FACILITIES

A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Common-Use Field Office: Of sufficient size to accommodate needs of construction personnel. Keep office clean and orderly. Furnish and equip offices as follows:

1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.

2. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
3. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.

2.3 EQUIPMENT

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

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

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

C. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

D. Heating: Provide temporary heating required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

E. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

F. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

G. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line(s) for each field office.

H. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

I. Parking: Provide temporary parking areas for construction personnel.

J. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties nor endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

K. Project Identification and Temporary Signs: Provide Project identification sign. Install signs where indicated to inform public and individuals seeking entrance to Project. Unauthorized signs are not permitted.

L. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with Division 1 Section "Cleaning" for progress cleaning requirements.

M. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

3.3 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

B. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.

1. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

C. Stormwater Control: Comply with authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

D. Site Enclosure Fence: Before construction operations, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.

E. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

F. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.

1. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
2. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

3.4 OPERATION, TERMINATION, AND REMOVAL

A. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

B. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

END OF SECTION

SECTION 016000– PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included: This Section contains definitions, product requirements and requirements for prior approved items.

B. Delivery and storage of materials and equipment.

C. Procedures for selecting products and approving substitutions.

1.2 DEFINITIONS

A. General: Definitions are not intended to negate the meaning of other terms used in Contract Documents, including specialties, systems, structure, finishes, accessories, furnishings, special construction, and similar terms, which are self-explanatory and have recognized meanings in the construction industry.

B. Products: Purchased items for incorporation into the Work, regardless of whether specifically purchased for Project or taken from Contractor's stock of previously purchased products.

C. Materials: Products which must be substantially cut, shaped, worked, mixed, finished, refined, or otherwise fabricated, processed, installed, or applied to form units of Work.

D. Appliances, Equipment, and Fixtures: Products with operational parts, regardless of whether motorized or manually operated and particularly including products with service connections (wiring, piping, etc.).

E. System: A unit of Work (i.e., structural system, vacuum system, etc.) shown or specified to include particular products, materials, appliances, equipment, or fixtures.

F. Substitutions: Where products, materials, appliances, equipment, or fixtures are listed by trade name(s), manufacturer name(s), or catalog reference(s) or where these items are shown or specified as part of a system or systems, items or systems proposed for use by Contractor that are not listed or differ from those shown or specified as part of a system will be considered substitutions.

1. Submit substitutions in accordance with requirements of this Section.

2. The requirements for substitutions do not apply to specified Contractor options. Revisions to Contract Documents, where requested by Owner or Architect are changes, not substitutions.

3. Contractor's determinations of and compliance with governing regulations and orders issued by governing authorities do not constitute substitutions, and do not constitute a basis for change orders; except as provided for under substitution procedures in this Section or elsewhere in

Contract Documents.

G. Prior -to-Bid Approvals: Products, materials, appliances, equipment, fixtures, or systems that have been proposed as substitutions and accepted by Owner prior to bid.

1.3 DESCRIPTION

A. General: Specific products, materials, appliances, equipment, fixtures, accessories, manufacturers, and proprietary mentioned by name, grade, or brand, in Specifications or on Drawings have been selected for their particular fitness, availability, and desirability for use appropriate to Work of this Project and are intended to establish the standard of quality.

B. Compliance: The compliance requirements, for individual products are multiple in nature and may include generic, descriptive, proprietary, performance, prescriptive, compliance with standards, compliance with codes, conformance with graphic details, and other similar forms and methods of indicating requirements.

1.4 PRODUCT REQUIREMENTS

A. General: Provide products which comply with requirements, and which are undamaged and unused at time of installation, and which are complete with accessories, trim, finish, safety guards, and other devices and details needed for a complete installation and for intended use.

1. Materials shall be new unless otherwise specified and unused, except for testing of current production models on date of order, undamaged, and un-deteriorated at time of use.

2. Identify materials in accordance with accepted trade standards and requirements of this Section.

3. Select and use methods or processes, including intermediate processes, which will produce the specified finished material or product.

4. Ascertain that the Work, including materials, products, and equipment delivered and installed, is in full compliance with the Contract Documents and appropriate submittals.

5. Standard Products: Where available, provide standard products of types which have been produced and used previously and successfully on other projects and in similar applications.

6. Continued Availability: Where additional amounts of product, by nature of its application, are likely to be needed by Owner at a later date for maintenance and repair or replacement work, provide a standard, domestically produced product which is likely to be available to Owner at such later date.

B. Nameplates: Except as otherwise indicated for required approval labels and operating data, do not permanently attach or imprint manufacturer's or

producer's nameplates or trademarks on exposed surfaces of products which will be exposed to view either in occupied spaces or on exterior of the Work.

1. Labels: Locate required labels and stamps on a concealed surface or, where required for observation after installation, on an accessible surface which, in occupied spaces, is not conspicuous.

2. Equipment Nameplates: Provide permanent nameplate on each item of service-connected or power-operated equipment. See sections specifying equipment requirements for specifics.

1.5 QUALITY ASSURANCE

A. Special Requirement: Due to certain Owner requirements, Owner will not consider substitutions on certain items. Therefore, substitutions will not be considered for items followed by the words: "no substitution(s)."

B. Architect's Compensation:

1. Except as limited by provisions of Owner-Architect or Owner-Contractor Agreements, Contractor shall reimburse Owner for compensation paid to Architect for evaluation of substitution proposals made during construction, whether or not substitution is accepted by Owner.

2. Refer to Request for Substitution form at the end of this Section.

C. Delays and Costs:

1. Substitution proposals made during construction shall be in accordance with procedures outlined in this Section, and be made in sufficient time to allow for adequate time for Architect's review and evaluation.

2. Delays and added costs associated with inadequate supportive data, necessary extended evaluations, or redesign work caused by substitutions shall be borne by Contractor.

3. Cost changes resulting from proposed substitutions shall be clearly stated with the initial substitution proposal. Subsequently discovered costs resulting from the substitution shall be borne by Contractor.

1.6 TRANSPORTATION AND HANDLING

A. Transport products by methods to avoid product damage; deliver in undamaged condition in manufacturer's unopened containers or packaging, dry.

B. Provide equipment and personnel to handle products by methods to prevent soiling or damage.

C. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.

D. Deliver products in the manufacturer's sealed container or other packaging

system, complete with labels and instructions for handling, storing, unpacking, protecting and installing.

1.7 STORAGE AND PROTECTION

A. Store Products in accordance with manufacturer's instructions, with seals and labels intact and legible.

B. Store sensitive products in weathertight enclosures; maintain within temperature and humidity ranges required by manufacturer's instructions.

C. For exterior storage of fabricated products, place on sloped supports above ground. Cover products subject to deterioration with impervious sheet covering; provide ventilation to avoid condensation.

D. Store loose granular materials on solid surfaces in a well-drained area; prevent mixing with foreign matter.

E. Arrange storage to provide access for inspection, periodically inspect to assure products are undamaged and are maintained under required conditions.

F. After installation, provide covering to protect products from damage from traffic and construction operations, remove when no longer needed.

1.8 PROCEDURES

A. Procedures for Selecting Products: Contractor's options for selecting products are limited by Contract Document requirements and governing regulations, and are not controlled by industry traditions or procedures experienced by Contractor on previous construction projects.

1. Single Product/Manufacturer Name:

a. Provide product indicated. Do not offer to provide an unnamed product unless it has been accepted under substitution provisions listed below.

b. Except as otherwise indicated, "Named" is defined to mean manufacturer's name for product as recorded in latest issue of published product literature as of date of Contract Documents.

c. Refer to requests to use products of a later (or earlier) model to Architect for acceptance before proceeding.

2. Two or More Product/Manufacturer Names:

a. Provide 1 of the named products, at Contractor's option.

b. Do not offer to provide an unnamed product unless it has been accepted under substitution provisions listed below.

3. Performance Requirements:

a. Provide products which comply with specific performances indicated and which are recommended by manufacturer (in published product literature or by individual certification) for application indicated.

b. Overall performance of a product is implied where product is specified for specific performances.

4. Standards, Codes, and Regulations: Where compliance with an imposed standard, code, or regulation is required, selection from among products which comply with requirements of those standards, codes, and regulations is Contractor's option.

5. Prescriptive Requirements: Provide products which have been produced in accordance with prescriptive requirements, using specified ingredients and components, and complying with specified requirements for mixing, fabricating, curing, finishing, testing, and similar operations in manufacturing process.

6. Visual Matching:

a. Where matching of an established sample is required, final judgment of whether a product proposed by Contractor matches sample satisfactorily is Architect's judgment.

b. Where no product exists within specified cost category, which matches sample satisfactorily and complies with requirements, comply with provisions concerning, substitutions and change orders for selection of an equivalent product.

7. Visual Selection:

a. Where specified product requirements include "color(s), pattern(s), texture(s), etc. selected by Architect" or words of similar effect, selection of manufacturer and basic product (complying with requirements) is Contractor's option, and subsequent selection of color(s), pattern(s), and texture(s), etc. is Architect's selection.

b. Where specified product requirements include "color(s), pattern(s), texture(s), etc., to match Architect's sample" or words to that effect, selection of product (complying with requirements, and within established cost category) is Architect's selection, including designation of manufacturer where necessary to obtain desired color, pattern, or texture.

1.9 SUBSTITUTION PROCEDURES

A. Prior (-to-Bid) Approvals: Substitute products, materials, appliances, equipment, fixtures, or systems will be considered by Architect.

1. Any bidder, material supplier, or manufacturer desiring to propose substitution(s) shall:

a. Submit in a sealed envelope catalog cuts, shop drawings, or other descriptive literature for products, materials, appliances, equipment, fixtures, or systems for proposed substitution.

b. Submit not later than 14 calendar days before bid opening

1. Make request to Architect in triplicate on copies of Request for Substitution form included at end of this Section.

2. Submittal(s) shall include a complete and adequate analysis showing point-for-point comparison to specified item(s) or system(s) and must prove equality or superiority.

3. Include related Section and Drawing number(s), and fully document compliance with requirements for substitutions.

4. Include product data/drawings, description of methods, samples.

   a. Where applicable, statement of effect on construction time and coordination with other affected Work.

   b. Cost information for proposal.

5. Include identification of previous use locally with dates and names of Architect and Owner.

6. Anything less will not be considered.

7. Equivalency:

   a. The Architect will be the initial judge of equivalency of proposed substitution(s).

   b. Architect will make written recommendation of acceptance or rejection to Owner.

8. Satisfaction:

   a. Prior to proposing substitution(s), certify that item or system is equal to that specified.

   b. That it will fit into space allocated.

   c. That item affords comparable ease of operation, maintenance, and service.

   d. That appearance, longevity, and suitability for climate and use are comparable to item specified.

   e. That substitution is in Owner's interest.

9. Manufacturer's data which is readily available to Architect is not acceptable for establishing proof of quality.

a. Provide laboratory test data performed by a nationally recognized independent testing laboratory known for its testing expertise.

b. Laboratory test shall include types of materials used in substitute item or system, including their thickness and strength, and a direct comparison to item or system specified for capacities, capabilities, coatings, functions, life cycle usage, and operations.

c. No change in Architect's design intent will be allowed where item or system will be exposed and where it will be used.

10. Proof: Burden of proof that a proposed substitution is equal or equivalent to a specified item or system shall be upon Contractor, who shall support his request with sufficient test data, samples, brochures, and other means to permit Architect to make a fair and equitable decision on merits of proposal.

11. Based on Architect's written recommendation of acceptance or rejection, Owner will determine acceptability of proposed substitutions.

12. Architect will notify Bidders of Owner's acceptance not later than 5 calendar days prior to bid opening via an addendum to the Contract Documents listing only accepted substitutions.

13. Responsibility: Acceptance of substitutions shall not relieve Contractor from responsibility for complying with all other requirements of the Contract Documents and coordinating substitution(s) with adjacent materials and other affected equipment.

B. During Construction:

1. Substitutions will not be considered when they are indicated or implied on submittals without separate written request prior to submittal, or when acceptance will require substantial revision of Contract Documents.
2. Architect and Owner will consider requests from Contractor during construction for substitutions (following procedures outlined above for prior approvals) only under 1 or more of the following conditions:

a. Substitution is required for compliance with subsequent interpretation of code requirements or insurance regulations.

b. Shown or specified item or system cannot be provided within Contract Time or becomes unavailable due to no fault of Contractor.

c. Subsequent information disclosed inability of item(s) or system(s) to perform properly or to fit in designated space, or manufacturer(s) refuse(s) to certify or warrant performance as required.

d. When, in Architect's judgment, a substitution would be substantially in Owner's best interests in terms of cost (substantial credit), time, or other valuable considerations, after deducting offsetting responsibilities Owner may be required to bear, including additional compensation to Architect for evaluation and redesign

services, increased cost of other work by Owner or separate contractors, and similar considerations.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION

REQUEST FOR SUBSTITUTION

A. Completed reproduction of this form shall accompany all requests for substitutions. Failure to submit form with request shall be cause for rejection. Substituted items or systems may be incorporated into the Work only after receipt of Owner's written approval. Fill in all applicable spaces and cross out all nonapplicable information bracketed ([]) or unbracketed.

[Subcontractor:] [Material Supplier:] [Manufacturer:] Date:
Requested Substitution:
Reference: Specification Section_____Drawing Reference _____
Reason for Substitution: [Prior Approval] [During Construction]:

B. Resulting Change to Contract Amount: [Add] [Deduct]_____
(Include supporting documentation.)

C. For substitutions made during construction the Architect will, upon receipt of substitution proposal, fill in the following compensation information, add it to or deduct it from the Change to the Contract Amount and submit Net Change to Contract Amount to Owner for approval. Upon receipt of Owner's approval, Architect will proceed with substitution review.

D. Architect's Fee for Substitution Evaluation:_____
E. Architect's Fee for Changes to Contract:_____

F. Documents Due to Substitution:
Net Change to Contract Amount (B + C + D): [Add] [Deduct]
Resulting Change to Contract Time: Add _____Deduct _____
Summary of Related Work Requiring Coordination (if any):

(Contractor shall assume responsibility for complete coordination with Work of all trades involved if Substitution Request is approved.)

G. Attached Documentation: The following is herewith attached to provide complete documentation of requested substitution:

[ ]Product Data [ ]Samples [ ]Shop Drawings
[ ]Test Reports [ ]Other:

H. Contractor's Signature

Subcontractor's/Supplier's/Manufacturer's
Signature

SECTION 017600 – GUARANTIES AND WARRANTIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes requirements for guaranties and warranties for contract closeout and during specified guaranty/warranty periods.

1.2 DESCRIPTION OF REQUIREMENTS

A. General Limitations: It is recognized that specific guaranties and warranties are intended to protect Owner against failure of the Work to perform as required, and against deficient, defective, and faulty materials and workmanship, regardless of sources.

B. Related Damages and Losses: When correcting guarantied or warranted work which has failed, remove and replace other Work of Project which has been damaged as a result of such failure or which must be removed and replaced to provide access for correction of Work.

C. Reinstatement of Guaranty or Warranty Period: In addition to requirements in the General Conditions, when Work covered by a special project guaranty or product warranty has failed and has been corrected by replacement or restoration, reinstate guaranty or warranty by written endorsement for 1 year starting on date of acceptance of replaced or restored Work.

D. Replacement Cost, Obligations: Except as otherwise indicated, cost of replacing or restoring failing guaranties or warranted units or products is Contractor's obligation, without regard for whether Owner has already benefitted from use through a portion of anticipated useful service lives.

E. Rejection of Warranties: Owner reserves the right, at time of Substantial Completion or thereafter, to reject coincidental product warranties submitted by Contractor, which in opinion of Owner detract from or confuse interpretation of requirements of Contract Documents.

F. Contractor's Procurement Obligations: Do not purchase, subcontract for, or allow others to purchase or subcontract for materials or units of Work for Project where a special project guaranty, specified product warranty, certification, or similar commitment is required until it has been determined that entities required to sign or countersign such commitments are willing to do so.

G. Specific Guaranty or Warranty Forms: Where a special project guaranty or specified project warranty is required, prepare a written document to contain terms and appropriate identification; ready for execution by required parties.

1. A sample form is attached as the last article of this Section.

2. Refer to individual sections of Divisions 2 through 33 for specific content and requirements.

3. Submit draft to Owner for approval prior to final executions.

1.3 REQUIREMENTS INCLUDED

A. Compile specified warranties.

B. Compile specified service and maintenance contracts.

C. Co-execute submittals when so specified.

D. Review submittals to verify compliance with Contract Documents.

E. Submit to Architect for review and transmittal to Owner.

1.4 SUBMITTAL REQUIREMENTS

A. Assemble warranties, bonds, and service and maintenance contracts, executed by each of the respective manufacturers, suppliers, and subcontractors.

B. Number of original signed copies required: 2 each.

C. Table of Contents: Neatly typed, in orderly sequence. Provide complete index information for each item.

1. Product or work item with index number to bound item.

2. Firm, with name of principal, address, and telephone number.

3. Scope.

4. Date of beginning of warranty, bond or service and maintenance contract.

5. Duration of warranty, bond, or service maintenance contract.

6. Provide information for Owner's personnel:

a. Procedure to be followed in case of failure.

b. Circumstances which might affect the validity of warranty or bond.

7. Contractor, name of responsible principal, address and telephone number.

1.5 FORM OF SUBMITTALS

A. Prepare in duplicate packets.

B. Format:

1. Size 8-1/2 x 11 inches on punched sheets for standard 3-ring binder.

a. Fold larger sheets to fit into binders.

2. Warranty-Guaranty wording shall be as printed below.

3. Cover: Identify each packet with typed or printed title "GUARANTIES AND WARRANTIES". List:

a. Title of Project.

b. Name of Contractor.

C. Binders: Commercial quality, 3-ring, with durable and cleanable plastic covers.

1.6 TIME OF SUBMITTALS

A. Make submittals within 10 days after date of Substantial Completion prior to final request for payment.

B. For items or work, where acceptance is delayed materially beyond Date of Substantial Completion, provide updated submittal within 10 days after acceptance, listing date of acceptance as start of warranty period.

1.7 SUBMITTALS REQUIRED

A. Submit warranties, bonds, service and maintenance contracts as specified in respective Sections of Specifications and as follows:

1. Provide when noted in individual Sections of the Project Manual Divisions 2 through 33.

1.8 SAMPLE FORM OF WARRANTY-GUARANTY

A. Print or type Warranty-Guaranty on installing contractor's own letterhead.

B. Wording and signatures required.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION

A. GUARANTEE-WARRANTY

When required by the specifications, warranties and/or guarantees other than one year shall be in the form of the following on the Contractor's own letterhead:

"GUARANTEE-WARRANTY FOR INTERMOUNTAIN HEALTHCARE, AVC Infusion Services project.

We hereby warrant and the General Contractor and/or Material Manufacturer guarantee that the (name of product, equipment or system) that we have installed in the 'AVC Infusion Services' project, has been done in accordance with the Contract Documents and that the work as installed will fulfill the requirements of the guaranty-warranty included in the specifications. We agree to repair or replace any or all of our work, together with any other adjacent work which may be displaced by so doing, that may prove to be defective in its workmanship or material within a period of _____ years from the date of Substantial Completion, without any expense whatsoever to the Owner, ordinary wear and tear and unusual abuse or neglect excepted.

In the event of our failure to comply with the above mentioned conditions within sixty (60) days after being notified in writing by the Owner, we collectively or separately do hereby authorize the Owner to proceed to have said defects repaired and made good at our expense, and we will honor and pay the costs and charges therefore upon demand.

Signed _____ (Subcontractor)
Name _____ (Print)
Company _____
Address _____
_____
License No. _____

Countersigned _____ (General Contractor)
Name _____ (Print)
Company _____
Address _____
_____
License No._____

Countersigned _____
(Material Manufacturer)
Name _____
Company _____
Address _____

SECTION 017823 – OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

PART 2 - RELATED DOCUMENTS

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

2.2 SUMMARY

A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.
2. Emergency manuals.
3. Operation manuals for systems, subsystems, and equipment.
4. Maintenance manuals for the care and maintenance of products, materials, and finishes.

B. Related Sections include the following:

1. Division 1 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
2. Division 1 Section "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.
3. Divisions 2 through 33 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

2.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

2.4 SUBMITTALS

A. Final Submittal: Submit one copy one of each manual in final form at least 15 days before final inspection. Architect will return copy with comments within 15 days after final inspection.

1. Correct or modify each manual to comply with Architect's comments. Submit 3 copies of each corrected manual within 15 days of receipt of Architect's comments.

2.5 COORDINATION

A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

PART 3 - OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Organization: Include a section in the directory for each of the following:

1. List of documents.
2. List of systems.
3. List of equipment.
4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

3.2 MANUALS, GENERAL

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name, address, and telephone number of Contractor.
6. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

1. Binders/Maintenance Manuals: Organize operation and maintenance data into suitable sets of mangeable size. Binders shall be Red Buckram binders with easy view metal for sheet size 11" X 8 ½" with expandable metal capacity as required for the project, rivet through construction with library corners using #12 BB and lining with same materials as cover, front cover and back-bone foil stamped in white. Binders shall be as manufactured by Hiller Bookbinding or equal. The master index sheet and each tabbed index sheet shall be AICO Gold-Line indexes or equal. Mark appropriate identification on front spine of each binder. Include the following types of information:

a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.

2. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
3. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

3.3 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

3.4 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions.
2. Performance and design criteria if Contractor is delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

1. Product name and model number.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

3.5 PRODUCT MAINTENANCE MANUAL

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

3.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard printed maintenance instructions and bulletins.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Aligning, adjusting, and checking instructions.
5. Demonstration and training videotape, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

EXECUTION

3.7 MANUAL PREPARATION

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.

1. Do not use original Project Record Documents as part of operation and maintenance manuals.
2. Comply with requirements of newly prepared Record Drawings in Division 1 Section "Project Record Documents."

F. Comply with Division 1 Sections for schedule for submitting operation and maintenance documentation.

END OF SECTION

SECTION 017839 – PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.

B. Related Sections include the following:
1. Division 1 Section for general closeout procedures.
2. Division 1 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
3. Divisions 2 through 33 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.3 SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set(s) of marked-up Record Prints.

a. Final Submittal: Submit one set(s) of marked-up Record Prints showing modifications for trades involved in the project.

B. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit one copy of each Product Data submittal.

1. Where Record Product Data is required as part of operation and maintenance manuals, submit marked-up Product Data as an insert in manual instead of submittal as Record Product Data.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.

1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.

a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
b. Accurately record information in an understandable drawing technique.
c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.

2. Content: Types of items requiring marking include, but are not limited to, the following:

a. Dimensional changes to Drawings.
b. Revisions to details shown on Drawings.
c. Depths of foundations below first floor.
d. Locations and depths of underground utilities.
e. Revisions to routing of piping and conduits.
f. Revisions to electrical circuitry.
g. Actual equipment locations.
h. Duct size and routing.
i. Locations of concealed internal utilities.
j. Changes made following Architect's written orders.
k. Details not on the original Contract Drawings.
l. Field records for variable and concealed conditions.

3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

2.3 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.

B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

END OF SECTION

SECTION 017900 - CLEANING

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included: Requirements for periodic, general, and final cleaning of the project.

B. Provide temporary and periodic clean-up of extra materials, waste and general debris during construction of the work, together with the final clean-up and cleaning, polishing and other "housekeeping" required to bring various surfaces to an acceptable condition prior to final inspection, or before additional work is done during construction.

C. This Section includes requirements for Cleaning for all phases of the Project. Some requirements of this Section may not be applicable to individual project Phases.

1.2 GENERAL REQUIREMENTS

A. Maintain premises and public properties free from accumulations of waste, debris, and rubbish in accordance with applicable safety and insurance standards and local ordinances.

B. The acceptable level of cleanliness of the Project shall be the decision of the Architect.

1. Work necessary to achieve such acceptable state shall be performed when required.

C. Burning: Burning of waste materials and/or rubbish on Site is not permitted.

1.3 CLEAN-UP DURING CONSTRUCTION

A. During construction, provide cleaning-up as follows:

1. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

2. Remove debris and rubbish from pipe chases, plenums, down spouts, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

3. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

4. Remove waste materials, debris, and rubbish from site weekly, or more often if needed, and dispose off-site in compliance with local regulations.

5. Storage areas: Ensure that materials to be used for construction are stored in designated structures or areas by the appropriate trades.

Maintain such areas or structures in a clean condition for the life of the Project.

6. Containers: Provide appropriate containers, such as dump containers, and locate on site for collection of waste materials and rubbish.

7. Supervision: Oversee all cleaning of areas by the trades using them. Ensure that resulting accumulations are deposited in appropriate containers.

8. Clean-up: Daily, weekly, or as necessary, clean-up floors and Site areas. Remove all loose materials, by sweeping if necessary.

1.4 FINAL CLEANING

A. Provide final clean-up and polishing just prior to final inspection and/or acceptance of the work of the Project.

B. Preparation:

1. Prior to final inspection, remove all loose material of any nature, except spare parts, loose furniture or furnishings, manuals, parts books, and similar items.

2. Remove all temporary buildings, utility lines or pipes and other work of a temporary nature.

3. Remove all temporary wrappings. Leave no trace of wrap or adhesive.

C. Surface Cleaning:

1. Special cleaning for specific units of Work as specified and as shown on Drawings.

2. Provide final cleaning of the Work, at time indicated, consisting of cleaning each surface or unit of Work to normal "clean" condition expected for a first-class building cleaning and maintenance program.

3. Comply with manufacturer's instructions for cleaning operations.

D. The following are examples, but not by way of limitation, of cleaning levels required:

1. Remove labels which are not required as permanent labels.

2. Clean transparent materials, including mirrors and window/door glass, to a polished condition, removing substances which are noticeable as vision-obscuring materials. Replace broken glass and damaged transparent materials.

3. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of dust, stains, films, and similar noticeable distracting substances.

a. Except as otherwise indicated, avoid disturbance of natural weathering of exterior surfaces.

b. Restore reflective surfaces to original reflective condition.

4. Wipe surfaces of mechanical and electrical equipment clean, including elevator equipment and similar equipment; remove excess lubrication and other substances.

5. Remove debris and surface dust from limited-access spaces including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.

6. Clean concrete floors in unoccupied spaces broom clean.

7. Vacuum clean carpeted surfaces and similar soft surfaces.

8. Clean plumbing fixtures to a sanitary condition, free of stains including those resulting from water exposure.

9. Clean light fixtures and lamps so as to function with full efficiency.

10. Clean Project Site (staging areas, Contractor Parking areas), including landscape development areas, of litter and foreign substances.

11. Sweep paved areas to a broom-clean condition; remove stains, petro-chemical spills, and other foreign deposits.

E. Pest Control: Engage an experienced exterminator to make a final inspection of Project, and to rid Project of rodents, insects, and other pests.

F. Removal of Protection: Except as otherwise indicated or requested by Hospital Representative, remove temporary protection devices and facilities which were installed during course of Work to protect previously completed Work during remainder of construction period.

G. Compliances:

1. Comply with safety standards and governing regulations for cleaning operations.

2. Do not burn waste materials at site, or bury debris or excess materials on the property, or discharge volatile or other harmful or dangerous materials into drainage systems.

3. Remove waste materials from site and dispose of in a lawful manner.

H. Moving Parts: Lubricate moving parts as recommended by the parts manufacturer, or as directed by the Architect. Wipe clean, all surplus lubricants.

I. Protection: Protect finished floors from damage due to traffic or other causes.

END OF SECTION

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Demolition and removal of selected portions of a building or structure.
2. Repair procedures for selective demolition operations.

1.3 DEFINITIONS

A. Remove: Carefully detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

C. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site.

1.5 SUBMITTALS

A. Proposed Dust-Control and Noise-Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.

1.6 PROJECT CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

B. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.

1. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from authorities having jurisdiction.

C. Owner assumes no responsibility for condition of areas to be selectively demolished.

1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. If materials suspected of containing hazardous materials are encountered in the work, Contractor will be responsible for removal and disposal of all materials. A copy of an Asbestos Report will be provided to the Contractor prior to construction beginning. See Bid Proposal for unit price to remove hazardous materials.

E. Storage or sale of removed items or materials on-site will not be permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

3.2 UTILITY SERVICES

A. Existing Utilities: Maintain services indicated to remain and protect them against damage during selective demolition operations.

B. Do not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.
1. Provide at least 72 hours' notice to Owner if shutdown of service is required during changeover.

C. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utilities serving areas to be selectively demolished.

3.3 PREPARATION

A. Temporary Enclosures: Provide temporary enclosures for protection of existing building and construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.

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

3.4 SELECTIVE DEMOLITION

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
3. Dispose of demolished items and materials promptly.

B. Existing Facilities: Comply with building manager's requirements for using and protecting building facilities during selective demolition operations.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

END OF SECTION

SECTION 035300– CONCRETE TOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included: Provide and install concrete toppings (cementitious underlayments), complete, as shown on Drawings and as specified, including:

1. Miscellaneous tapers and warps for alignment of top-of-finish flooring at transitions between materials of different heights and thickness, including:

a. Section 093000 – Tile.

b. Section 096519 – Resilient Tile Flooring.

c. Section 096813 – Tile Carpeting

d. Concrete Floors without finish or painted finish.

2. Remedial correction of interior floor slabs to provide specified floor flatness as specified in Section 033000 – Cast-in-Place Concrete; at no additional cost to Owner.

B. Work Specified Elsewhere:

1. Section 033000 – Cast-in-Place Concrete. Use concrete from this Section when the thickness is at least 2-inches.

2. Section 093000– Tile; Polymer-modified mortars for tile assemblies sloped to drains.

1.2 SUBMITTALS

A. Comply with requirements of Section 013300 – Submittal Requirements.

B. Product Data: Manufacturer's literature describing materials and specifications for mixing, placing, curing, and protecting.

1.3 QUALITY ASSURANCE

A. Applicator: Approved and trained by manufacturer.

B. Design Criteria:

1. Compressive Strength: Minimum 4,100-PSI at 28 Days per ASTM C109.

1.4 PRODUCT HANDLING

A. Delivery: Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use.

B. Storage: Ensure storage facilities are weathertight and dry.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. General: Ardex Inc; Dependable Inc; or approved equal. Ardex products are specified as Basis-of-Design

2.2 MATERIALS

A. Concrete Topping Types:

1. Self-Leveling Type for Interior Applications: Ardex K-15, or approved equal; 4,100-PSI compressive strength, 16-hour curing time. Installs from feather-edge depth to 1 1/2-inch depth without aggregate; installs up to 5-inch depth with addition of aggregate per manufacturer's written instructions.

2. Trowelable Fast-Setting Patch Type for Interior Applications: Ardex SD-P, or equal; 4,200-PSI compressive strength, 1-hour curing time. Installs from feather-edge depth to 1-inch depth without aggregate; installs up to 3-inch depth with addition of aggregate per manufacturer's written instructions.

3. Fast-Setting, Self-Leveling Type for Interior Applications: Ardex SD-T, or equal; 6,100-PSI compressive strength, 2-hour curing time. Installs from 1/4-inch to 2-inch depth without addition of aggregate, and up to 5-inches depth with addition of aggregate per manufacturer's written instructions.

4. Weather-Resistant, Self-Leveling Type for Interior Applications: Ardex A-300, 3,200-PSI compressive strength. Installs from 1/4-inch depth to 1/2-inch depth without aggregate; installs up to 3/4-inch depth with addition of aggregate per manufacturer's written instructions.

5. Polymer-Reinforced, Weather-Resistant Type for Interior Applications: Ardex Poly-Top, 5,500-PSI compressive strength. Installs from 1/4-inch depth to 1-inch depth without aggregate; installs up to 2-inch depth with addition of aggregate per manufacturer's written instructions.

6. Trowelable Fast-Setting Patch Type for Interior Applications: Ardex CD, 4,000-PSI compressive strength. Installs from 1/16-inch depth to 1/2-inch depth without aggregate.

B. Primer: Ardex P-51, or equal, and as recommended in writing by the topping manufacturer for the substrata to receive topping.

C. Aggregate:

1. Sand: 1/16-inch or less washed masonry sand, mortar sand, or plaster sand.

2. Gravel: 3/8-inch pea gravel.

D. Water: Clean and potable, free from impurities detrimental to underlayment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine substrate and verify that surfaces are free from debris and are reasonably clean and dry and that conditions are otherwise suitable to receive topping. Do not start Work until conditions are satisfactory.

3.2 PREPARATION

A. Cracks and Voids: Fill with trowelable fast-setting patch type concrete topping.

3.3 MIXES

A. General: Mix concrete toppings per manufacturer's recommendations.

B. Aggregates: Add sand or gravel aggregates to topping mix per manufacturer's recommendations for topping thickness.

3.4 INSTALLATION

A. General: Prime substrates, mix materials, and place toppings per manufacturer's recommendations.

B. Thickness: Install to thickness as shown or as required, spreading and screeding to smooth surface; abut level to existing surface.

C. Edge Forms: Provide as required.

D. Ramps and Slopes to Drains: Including other accommodations for level changes; form with trowelable fast-setting patch type cementitious underlayment.

1. Sloped-to-Drain Setting bed materials for Patient Bathrooms, Showers and Tub Rooms provided in 093000 – Tile.

E. Finish: As recommended by flooring manufacturer for reception of specified finish materials.

F. Exterior Work: Provide weather-resistant toppings at concealed locations or at the written direction of the Owner.

G. Transitions between Floor Finishes of differing thickness:

1. General: Provide concrete topping as required to align top-of-finish floor where flooring materials of different thickness meet.

2. Performance Criteria:

a. Provide concrete topping as required so that all offsets between adjacent floor materials are 1/8-inch or less.

b. Warp-applied concrete topping with a slope no greater than 1 inch in 48 inches, or a length of slope no less than 18 inches, whichever produces the more gentle transition.

3. Locations: Provide at locations where transitions between the following floor finishes occur that result in a vertical offset of greater than 1/8-inch:

a. Section 093000 – Tile.

b. Section 096519 – Resilient Flooring.

c. Section 096813 – Tile Carpeting.

d. Concrete Floors without finish or painted finish.

3.5 CURING

A. General: Allow concrete topping to harden as recommended by manufacturer.

B. Traffic: Do not permit traffic on topping during hardening period; minimum 2 hours or longer.

C. Loading: Do not load floors until reasonable strength has been achieved. Evenly distribute any loading on topping and prohibit concentrated loading.

D. Conditions: Maintain adequate ventilation and temperature above 50 degrees F. until topping is dry.

3.6 CLEANING AND REPAIR

A. General: Repair concrete topping damaged after installation as a result of other trades prior to installation of scheduled floor finish, if any, at no additional cost to Owner.

END OF SECTION

SECTION 050500 – METAL FASTENERS

Part 1 - GENERAL

1.1 SUMMARY

A. Work Included: This Section establishes general standards and requirements for metal fasteners utilized for attachment of items to the primary structure of the building and is incorporated in others Sections of these specifications where referenced, including:
   1. Expansion Bolts.
   2. Bolts, screws and other fasteners.

B. Work Specified Elsewhere:
   1. Division 5 – Miscellaneous Metal Fabrications.
   2. Division 23 – Mechanical.
   3. Division 26 – Electrical.

1.2 SUBMITTALS

A. Comply with provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Manufacturers' information on materials, fabrication, and installation. Include current ICC or IAPMO Reports and other information to substantiate compliance with Contract Documents.

C. Substitutions: Include with requests for substitution of fastening device type, minimum embedment, length, load capacity for pull out and shear, and installation torque of fasteners and statement that fastening devices meet or exceed requirements specified in Contract Documents.

1.3 QUALITY ASSURANCE

A. Field Quality Control:
   1. The Owner's Testing Lab will perform and report on tests and inspections as follows:
   2. Expansion Bolts:
      a. Test 50 percent of drilled-in anchorages to 2.0 times the allowable load specified with special inspection in tension.
      b. If any anchor fails testing, test all anchors of the same category installed that day until twenty consecutive anchors pass, then resume the initial testing frequency. Cost of this testing shall be borne by Contractor.

Part 2 - PRODUCTS

2.1 MATERIALS

A. Expansion Bolts: Hilti, Inc.'s Kwik Bolt TZ2, E.O.R. approved equivalent or as indicated. Provide stainless steel expansion bolts for exterior exposure.

B. Sheet Metal Screws: John Wagner Associates' Grabber or equal: Unless otherwise noted on Drawings, type to suit stud, track, or channel gauge and as follows.
   1. Where Overlaid with Gypsum Board or Other Finish Material:
      a. For Fastening to 20 Gauge and Lighter Material: No. 8 by 9/16-inch Wafer Head Streaker.
      b. For Fastening to 18 Gauge and Heavier Material: No. 8 by 1/2-inch Wafer Head Self-Drilling.

2. Where Not Overlaid with Finish Material:
   a. For Fastening to 20 Gauge and Lighter Material: No. 8 by 9/16-inch Hex Head Streaker.
   b. For Fastening to 18 Gauge and Heavier Material: No. 8 by 1/2-inch Hex Head Self-Drilling.

C. Nuts and Bolts: ASTM A307 with suitable nuts, in accordance with ASTM A563, and washers 1/4-inch diameter, unless otherwise noted.

D. U-Bolts: Special sizes and shapes shown; material as specified for nuts and bolts.

Part 3 - EXECUTION

3.1 INSTALLATION

A. Expansion Bolts: Install in predrilled holes for fastening items into concrete.
   1. Install expansion bolts according to the manufacturer's instructions as to tools, torque and tightening procedure.
   2. Expansion bolt locations and spacings: As shown.
   3. Edge Distance: Not less than 10 bolt diameters.
   4. Unless otherwise noted, install expansion bolts with manufacturer's recommended minimum embedments. Embedment length is exclusive of thickness of floor coverings, grout pads or other overlays.
   5. Do not recess expansion bolts more than one-fourth of the nominal bolt diameter. Abandon overdrilled holes or partially fill with nonshrink grout and redrill when grout has set.
   6. Abandon holes if the axis of a drilled hole deviates more than 5 degrees from normal to the concrete surface.
   7. If a concrete reinforcing bar is encountered during drilling, immediately terminate drilling and notify the Architect. Subject to review and approval the SEOR, the Architect may authorize using one of the following procedures:
      a. If the location may be shifted, fill abandoned hole with nonshrink grout and install expansion bolt with a minimum of 1/2 inch of sound concrete between the expansion bolt and the abandoned hole, or…
      b. If the location may not be shifted, use a diamond core drill to cut the rebar and drill the hole beyond the reinforcing such that the whole wedge portion of the expansion bolt can be expanded below the bar, or…
      c. If the location may not be shifted, core an oversize hole at the direction of the Architect and grout an acceptable anchor in place.

B. Fasten Work tightly to prevent rattle or vibration except where expansion-contraction tolerances are required.

C. When expansion bolts are installed through metal deck into concrete slab above, embedment shall not extend closer than 3/4-inch to top of concrete. Locate at center of bottom flute. Minimum embedment shall be 1-1/2-inches above top flute of decking.

D. Expansion Bolt Test Values:
   1. Test Procedure: Apply proof test loads by means of hydraulic ram, calibrating spring loading device, or torque wrench without removing nut if possible. If not possible, remove nut and install a threaded coupler to same tightness as original nut using a torque wrench.
   2. Test Equipment: Calibrated by approved testing laboratory per standard industry procedures.

3. Expansion Bolts shall withstand following minimum test loads for specified wedge type anchors:

Anchor Thread Size (diameter in inches)	Tension Test Load (lbs.)	Test Torque (ft-lbs.)
1/4	800	10
3/8	1100	25
1/2	2000	50
5/8	2300	80
3/4	3700	150
1	5800	250

4. Acceptance Criteria:
   a. Hydraulic Ram Method: Expansion bolt is acceptable if there is no observable movement nor loosening of washer at application of tension test load.
   b. Torque Wrench Method: Expansion bolt is acceptable if the test torque is reached within one-half turn of the nut.
5. Test Timing: Within 24 hours after expansion bolt installation and in the presence of the Inspector of Record.

END OF SECTION

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Structural steel.

B. Related Requirements:
1. Section 055000 "Metal Fabrications" for other steel items not defined as structural steel.

1.3 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data:

1. Structural-steel materials.
2. Threaded rods.
3. Shop primer.
4. Galvanized repair paint.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.

3. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Retain first three subparagraphs below for "high-seismic applications," as defined in ANSI/AISC 360.
4. Identify members not to be shop primed.

C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide in accordance with AWS D1.1/D1.1M for each welded joint whether prequalified or qualified by testing, including the following:

1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand-critical welds.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Mill test reports for structural-steel materials, including chemical and physical properties.

C. Product Test Reports: For the following:

1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
2. Tension-control, high-strength, bolt-nut-washer assemblies.

D. Source quality-control reports.

E. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).

B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. Angles: ASTM A36/A36M.

B. Plate and Bar: ASTM A36/A36M.

C. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade C structural tubing.

D. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS AND CONNECTORS

A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

2.3 RODS

A. Threaded Rods: ASTM A36/A36M.

1. Nuts: ASTM A63 heavy-hex carbon steel.
2. Washers: ASTM F436, Type 1, hardened ASTM A36/A36M carbon steel.
3. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.

2.4 PRIMER

A. Steel Primer:
1. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

2.5 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.

1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 3.

F. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.

2.6 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

2.7 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize roof hatch.

2.8 SHOP PRIMING

A. Shop prime steel surfaces, except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
4. Galvanized surfaces.
5. Surfaces enclosed in interior construction.

B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:
1. SSPC-SP 3.

C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner or in accordance with SSPC-SP 16.

D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.9 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.

1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
2. Bolted Connections: Inspect and test shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

a. Liquid Penetrant Inspection: ASTM E165/E165M.
b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
c. Ultrasonic Inspection: ASTM E164.
d. Radiographic Inspection: ASTM E94/E94M.

4. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.

B. Maintain erection tolerances of structural steel within ANSI/AISC 303.

C. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

D. Splice members only where indicated.

E. Do not use thermal cutting during erection.

F. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

3.5 REPAIR

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.

B. Touchup Painting:

1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

3.6 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

1. Bolted Connections: Inspect bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.

a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1) Liquid Penetrant Inspection: ASTM E165/E165M.
2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
3) Ultrasonic Inspection: ASTM E164.
4) Radiographic Inspection: ASTM E94/E94M.

END OF SECTION 051200

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Miscellaneous framing and supports.
2. Miscellaneous steel trim.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for steel framing, supports, door frames, and other steel items attached to the structural-steel framing.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Fasteners.
2. Shrinkage-resisting grout or epoxy grout.
3. Slotted Channel Framing.
4. Post-installed anchorage.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Reproductions of the original structural drawings will be rejected.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates:

1. Mill Certificates: Signed by stainless steel manufacturers, certifying that products furnished comply with requirements.
2. Welding certificates.

B. Research Reports: For post-installed anchors.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:

1. AWS D1.1, "Structural Welding Code - Steel."

1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36.

C. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4. Galvanized Steel: ASTM A653.

2.2 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.

C. Post-Installed Anchors: Torque-controlled expansion anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

2.3 MISCELLANEOUS MATERIALS

A. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

B. Concrete: Normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 4000 psi.

2.4 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

H. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

2.5 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts for units installed after concrete is placed.

2.6 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

2.7 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work.

2.8 GENERAL FINISH REQUIREMENTS

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of

shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

3.2 INSTALLATION OF MISCELLANEOUS STEEL TRIM

A. Anchor to concrete construction to comply with manufacturer's written instructions.

END OF SECTION

SECTION 061000- ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included: Rough carpentry, complete, as shown on Drawings and as specified, including:

1. Miscellaneous fire-treated blocking, backing and plywood as shown.

B. Work Specified Elsewhere:

1. Section 064123 – Interior Architectural Woodwork.

1.2 REFERENCE STANDARDS

A. American Plywood Association (APA):

1. Guide to Plywood Grades.

B. American Wood Preservers Association (AWPA):

1. C20; Structural Lumber - Fire-Retardant Treatment by Pressure Process.

2. C27; Plywood - Fire-Retardant Treatment by Pressure Process.

3. M4; Standard for the Care of Preservative-Treated Wood Products.

C. West Coast Lumber Inspection Bureau (WCLIB):

1. Standard Grading Rules for West Coast lumber.

D. Western Wood Products Association (WWPA):

1. Western Lumber Grading Rules.

1.3 SUBMITTALS

A. Comply with requirements of Section 013300 – Submittal Requirements.

B. Shop Drawings: Show specially fabricated rough hardware.

1.4 QUALITY ASSURANCE

B. Comply with latest edition of the following standards:

1. Western Coast Lumber Inspection Bureau (WCLIB) "Standard Grading Rules No. 16."

2. Western Wood Products Association (WWPA) "Grading Rules for Western Lumber."

3. American Plywood Association (APA) "Guide to Plywood Grades."

4. United States Product Standard (PS) "Construction and Industrial Plywood" (PS 1-74).

5. American Wood Preserver's Association (AWPA):

a. "Structural Lumber - Fire-Retardant Treatment by Pressure Process" (AWPA C27-74).

b. "Plywood - Fire-Retardant Treatment by Pressure Process" (AWPA C27-74).

C. Grade Marks: Identify all wood materials by official grade mark.

1. Lumber: Mark each piece of lumber with grade mark WCLIB (or WWPA) or of agency certified by WCLIB (or WWPA), and accompany each mill shipment to site by certificate of inspection by WCLIB (or WWPA) and FR-S where fire treatment is required.

2. Softwood Plywood: Show Type, Grade, Class and Identification Index; per APA Guide to Plywood Grades, and per requirements of NBS PS-1.

C. Fire-Retardant Treatment:

1. Fire-Retardant Treatment: UL classification FR-S.

2. Obtain each type of fire-retardant treated wood products from one source for both treatment and fire-retardant formulation.

D. Pressure treatment shall not adversely affect application, permanence, or appearance of finish paint systems.

1.5 PRODUCT HANDLING

A. Facilities: Provide proper facilities for handling and storage of materials to prevent damage to edges, ends, and surfaces.

B. Storage: Keep materials dry. Stack materials off ground on level flat forms, fully protected from weather.

1.6 PROJECT CONDITIONS

A. Environmental Requirements: Maintain uniform moisture content of lumber at not more than 19 percent before, during and after installation.

B. Sequencing and Scheduling: Coordinate details with other Work supporting, adjoining or fastening to rough carpentry Work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Wood (all wood shall be fire treated):

1. Lumber: Douglas fir; No. 3 or construction grade per WCLIB.

2. Plywood: NBS PS-1 - grade structural one, C-C exterior.

3. Use only material that is free of urea-formaldehyde.

B. Fasteners:

1. Nails: Common wire typical.

2. Powder-Actuated Devices (PAD): As specified in Section 050500 – Metal Fasteners.

3. Expansion Bolts: As specified in Section 050500 – Metal Fasteners.

4. Miscellaneous Hardware: Provide common screws, bolts, fastenings, washers and nuts, and other items required to complete rough carpentry Work.

5. Finish: Hot-dip galvanize fasteners for exterior work.

2.2 ROUGH HARDWARE

A. All exterior hardware shall be hot-dipped galvanized per ASTM A-123 Standards.

1. Nails:

a. Common wire for typical framing, blocking, etc. Box nails will not be allowed.

b. Annular ring common wire nails for plywood floor.

2. Bolts: Hexagonal heads, Grade A conforming to ASTM A307.

3. Washers: Washers for bearing against wood shall be provided under all bolt heads and nuts.

a. Malleable iron or steel plate having an area equal to 16 times the area of bolt or lag screw.

b. Steel washers shall have a thickness not less than 1/10 the length of the washer's longest side.

c. Malleable iron washers shall have a thickness not less than 1/2 the bolt or lag screw diameter and having a bearing surface for the nut or head equal in diameter to not less than the long diameter of the nut or head.

4. Anchor Bolts: Hexagonal heads, Grade A conforming to ASTM 307, 1-1/2-inch-diameter by 10 inch.

5. Rough Framing Connectors: KC Metal Products or approved equal. For connector type, see Drawings.

B. Powder Driven Fasteners, Expansion Bolts and Expansion Anchors: As specified under 050500 – Metal Fasteners.

2.3 FABRICATION

A. Lumber:

1. Moisture Content: Air- or kiln-dry to 19 percent maximum moisture content at time of surfacing.

2. Finish: Surfaced four sides, S4S, unless otherwise specified.

3. Size: Per rules of governing standard. Sizes shown are nominal unless otherwise specified.

B. Fire-Retardant Treated Lumber and Plywood: Pressure treat rough carpentry materials per Reference Standards to obtain specified UL Classification.

1. Type: Hoover Treated Wood Products, "Exterior Fire-X," or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine areas to receive rough carpentry Work and verify following:

1. Completion of installation of building components to receive rough carpentry Work.

2. That spacing, direction, and details of supports are correct to accommodate installation of blocking, backing, stripping, furring, and nailers.

3. That surfaces are satisfactory to receive Work. Do not commence installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Provide wood blocking, backing, furring, grounds, nailers, stripping, and similar items as detailed and otherwise required to anchor fixtures and equipment to be installed by other trades. Perform cutting, boring, and similar Work required. Install members true to line. Fit accurately. Secure rigidly. Provide special framing, even if not specifically shown, as required to properly complete Work.

B. Sills or Plates on Concrete: Set in grout if surface of concrete deviates from true plane by more than 1/16-inch in 4 feet. Anchor with bolts as shown. Use two bolts minimum per piece with one bolt located between 4 inches and 8 inches from each end of each piece of sill.

C. Nail Joints: Per minimum requirements of applicable code unless otherwise shown.

D. Plywood: Sheet layout, nailing and edge-blocking as shown. Gap joints 1/16-

inch. Butt joints accurately at centerlines of supporting members.

E. Fasteners:

1. General: Furnish and accurately locate items to be embedded in concrete. Secure such items in place before concrete is poured.

2. Nails: If wood tends to split, pre-drill holes three-fourths of nail diameter.

3. Lag Screws: Screw into place; do not hammer. Use soap or other lubricant to ease insertion. Pre-drill holes diameter of shank for unthreaded portion, two-thirds of shank diameter for threaded portion.

4. Bolts and Nuts: When installed, bear no more than 1/2-inch of threads on wood and allow no more than 1/2-inch of bolt to project beyond nut. Drill bolt holes 1/32-inch oversize. Tighten nuts snug when placed, and re-tighten at end of job or just before closing in.

5. Sheet Metal Fasteners: Nail or bolt per manufacturer's instructions. Nail or bolt holes. Use nails provided by manufacturer.

3.3 PLYWOOD BACKING FOR TELEPHONE AND ELECTRICAL EQUIPMENT

A. Panels: Not less than 3/4-inch thick. Use largest sizes practicable.

B. Joints: Tightly butt vee-joints.

C. Finish: Slightly ease exposed edges, sandpaper smooth as required.

D. Fastening: Secure to metal studs and backing plates with flat-head countersunk sheet metal screws at 12-inch centers at panel edges and at 16-inch centers in panel field.

END OF SECTION

SECTION 064123- INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Work Included: Provide and install Casework, complete, as shown on Drawings and as specified. All casework to be:

AWI Premium Grade Fabrications.

B. This Section includes the following:

1. Plastic-laminate cabinets.
2. Plastic-laminate countertops.
3. Solid-surfacing-material countertops and integral sinks.

C. Related Sections include the following:

1. Division 6 Section "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.
2. Division 8 Section "Flush Wood Doors."

1.3 DEFINITIONS

A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items, unless concealed within other construction before woodwork installation.

1.4 SUBMITTALS

A. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

B. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each type of material indicated.

1. Plastic laminates.
2. Shop-applied transparent finishes.

C. Samples for Verification:

1. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish.
2. Solid-surfacing materials, 6 inches square.
3. One sample door with required hardware.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed architectural woodwork similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Fabricator Qualifications:

1. Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
2. Shop is a certified participant in AWI's Quality Certification

C. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork, construction, finishes, and other requirements.

1. Provide AWI certification labels or compliance certificate indicating that woodwork complies with requirements of grades specified.

D. Single-sourcing materials: It is the intent of the Contract Documents to single-source plastic laminate and solid surface materials specified in this section when scheduled on the drawings to assure matching of specified finishes.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.7 PROJECT CONDITIONS

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

B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide materials that comply with requirements of the AWI quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

B. Wood Species and Cut for Transparent Finish:
1. Species: Maple (Acer Saccharun)
2. Application:
a. Cut: Plan Sliced
b. Figure: All light colored wood
c. Face Panel Grade: HPVA Grade A
d. Color: Stain to match patient room cabinets on adjacent floors

C. Wood Products: Comply with the following:

1. Hardboard: AHA A135.4.
2. Softwood Plywood: DOC PS 1, Medium Density Overlay.
3. Hardwood Plywood and Face Veneers: HPVA HP-1.

D. Thermoset Decorative Overlay: Particleboard complying with ANSI A208.1, Grade M-2, or medium-density fiberboard complying with ANSI A208.2, Grade MD, with surface of thermally fused, melamine-impregnated decorative paper complying with LMA SAT-

E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated, or if not indicated, as required by woodwork quality standard.

1. Manufacturer: Subject to compliance with requirements, provide high-pressure decorative laminates by one of the following:

a. Wilsonart

F. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2.

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

a. Solid Surface: Corian

2. Type: Standard slab type, unless Special Purpose type is indicated.
3. Colors and Patterns: as per finish schedule.

G. Solid-Surfacing Material: Quartz

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

a. Solid Surface (Quartz): Cambria Quartz (2cm)

2. Type: Standard slab type, unless Special Purpose type is indicated.
3. Colors and Patterns: As per finish schedule.

H. Adhesive for Bonding Plastic Laminate: Contact cement.

I. Edge-banding:
1. Edge-banding for cabinet body parts shall be purified **3 mm PVC** applied with hot melt glue by automatic edge-banding equipment.
2. Edge-banding for door and drawer fronts shall be purified 3 mm PVC applied with hot melt glue by automatic edge-banding equipment. Edges and corners shall be rounded with a 3 mm radius and scraped free from machining or chatter marks.
3. Color shall match vertical laminate at cabinets or as selected by Architect from manufacturer's full color range for solids and patterns.

J. Cores:

1. All sides, tops, countertops, bottoms, doors, drawer fronts, and partitions shall have minimum ¾" thick multi-core premium grade panel product cores manufactured for uses as a core material for laminated casework. Provide 1-inch thickness for bottom panel of wall hung units (same as shelves).
2. Shelf Cores: Shelves shall have the same core material as specified for the cabinet body except provide 3/4-inch thickness.
3. Multi-Core Panel Products:

Simpson Plyron, Simpson
States Industries "Armorcore"
True North "**Multi - Core**"

2.2 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.

B. Hardware Standard: Comply with BHMA A156.9 for items indicated by referencing BHMA numbers or items referenced to this standard.

C. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 170 degrees of opening, self-closing.

D. Door and Drawer Pulls: Back mounted, 4 inches long, wire pull, Finish- Satin Nickel, 5/16" in diameter.

E. Catches: Magnetic catches, BHMA A156.9, B03141.

F. Shelf Rests: BHMA A156.9, B04013.

G. Drawer Slides: Side-mounted, full-extension, zinc-plated steel drawer slides with steel ball bearings, BHMA A156.9, B05091, and rated for the following loads:

1. Box Drawer Slides: 100 lbf.
2. Pencil Drawer Slides: 45 lbf.

H. Door Locks: BHMA A156.11, E07121. **(Typical at base cabinets at sink locations)**

I. Drawer Locks: BHMA A156.11, E07041.

J. Keyboard Trays: VersaTables, 24 inches wide, 14inches deep, Model KD-2414

K. Grommets for Cable Passage through Countertops: 2-1/2-inch beige, molded-plastic grommets and matching plastic caps with slot for wire passage.

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

1. Satin Chromium Plated: BHMA 652 for steel base.

M. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

N. Keyless Security Locks : **(Typical at all upper/wall cabinets in Medication Room and as noted elsewhere)**

a. Keyless access
b. Four digit code
c. Power: Operates on two 1.5V AAA batteries
d. Operation: 15,000 openings
e. Low battery signal with battery failure override
f. Dimensions: 5-3/8 inches long by 1-1/4 inches wide by 1-3/16 inches deep to top of handle
g. Color: Selected by Architect
h. Public/private function
i. Base Product: Kit-Lock KL1000 by Codelocks Ltd.

2.3 INSTALLATION MATERIALS

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

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.4 FABRICATION, GENERAL

A. Interior Woodwork Grade: Provide **Premium Grade** interior woodwork complying with the referenced quality standard.

B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

C. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

2.5 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

A. Quality Standard: Comply with AWI Section 300.

B. Grade: **Premium.**

2.6 PLASTIC-LAMINATE CABINETS

A. Quality Standard: Comply with AWI Section 400 requirements for laminate cabinets.

B. Grade: **Premium**.

C. AWI Type of Cabinet Construction: Flush overlay.

D. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:

1. Horizontal Surfaces Other Than Tops: HGP.
2. Vertical Surfaces: VGS.
3. Edges: PVC T-mold matching laminate in color, pattern, and finish.

E. Materials for Semi-exposed Surfaces: Provide surface materials indicated below:

1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade VGS.
2. Drawer Sides and Backs: Melamine.
3. Drawer Bottoms: Melamine

F. Materials for Exposed Surfaces: Plastic Laminate

G. Retain one each from three groups below or revise to suit Project.

H. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. Provide Architect's selections from laminate manufacturer's full range of colors and finishes in the following categories:

a. Solid colors.
b. Patterns.

2.7 PLASTIC-LAMINATE COUNTERTOPS

A. Quality Standard: Comply with AWI Section 400 requirements for high-pressure decorative laminate countertops.

B. Grade: **Premium**.

C. High-Pressure Decorative Laminate Grade: HGS.

D. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. Provide Architect's selections from manufacturer's full range of colors and finishes in the following categories:

    a. Solid colors.
    b. Patterns.

E. Edge Treatment: Countertop front edge shall be bullnose type with same laminate cladding on horizontal surfaces. Side edge, that is visible, shall be finished with same laminate cladding on horizontal surfaces.

F. Core Material: Shall be ¾" thick solid plywood or high density particle board built up to 1-1/2".

G. Side Splash: Provide ¾" side splash at all locations where counter abuts perpendicular wall. Side splash shall be attached to wall but not to countertop to allow for expansion or contraction of countertop after installation.

2.8 SOLID-SURFACING-MATERIAL COUNTERTOPS

A. Grade: Premium.

B. Solid-Surfacing-Material Thickness: 1/2 inch, Finish 1-1/2"

C. Colors, Patterns, and Finishes: Provide materials and products that result in colors of solid-surfacing material complying with the following requirements:

1. Match project finish schedule. Provide Architect with sample for verification.

D. Fabricate tops in one piece, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.

1. Fabricate tops with shop-applied edges of materials and configuration indicated.
2. Provide **Integral** back splash.
3. Provide **Integral** side splash where countertop abuts perpendicular wall or cabinet.
4. Provide full bullnose edge at exposed edge of counter.
5. Provide ¾" radius edge at the top of back and side splash.

E. Integral Sinks: Provide factory fabricated integral sinks where shown and scheduled on Drawings.

1. Provide **Corian, Model 810P, Color: Glacier White OR Samsung Staron A3181, Color: Bright White BW010**

2.9 Wood Veneer Casework:

1. Applicable Standard: AWI Section 400A - Wood Cabinets.
2. Grade: Premium.
3. Construction Style: Flush overlay.
4. Scribing: Flush with door faces and per Premium Grade regardless of specified casework grade.
5. Materials:
   a. Exposed Surfaces: Hardwood plywood.
   b. Semi-Exposed Surfaces: Hardwood Plywood.
   c. Edges: Wood veneer tape banding to match exposed surfaces, not less than 1/16-inch-thick.

PART 3 - EXECUTION

3.1 PREPARATION

A. Condition woodwork to average prevailing humidity conditions in installation areas before installation.

B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Quality Standard: Install woodwork to comply with AWI Section 1700 for the same grade specified in Part 2 of this Section for type of woodwork involved.

B. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.

C. Scribe and cut woodwork to fit adjoining work, and refinish cut surfaces and repair damaged finish at cuts.

D. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation.

E. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible.

Do not use pieces less than 36 inches long, except where shorter single-length pieces are necessary.

F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head screws sized for 1-inch penetration into wood framing, blocking, or hanging strips.

G. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Secure backsplashes to tops and to walls.
3. Calk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."
4. Cut circular openings in countertop for electrical cord access below countertop. Provide a grommet around opening for finish appearance. Color of grommet to match countertop. The number of openings required will be determined by the Owner but will not exceed 250.
5. Cut openings in countertops for the installation of grilles as indicated on the drawings and as approved by Architect.
6. Provide full bullnose edge, Typical

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean woodwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION

SECTION 078100 - APPLIED FIREPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes sprayed fire-resistive materials.

B. Related Requirements:

1. Section 078123 "Intumescent Fireproofing" for mastic and intumescent fire-resistive coatings.
2. Section 099646 "Intumescent Painting" for intumescent paints that are fire retarding but not fire resistive.

1.3 DEFINITIONS

A. SFRM: Sprayed fire-resistive materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review products, design ratings, restrained and unrestrained conditions, densities, thicknesses, bond strengths, and other performance requirements.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Framing plans or schedules, or both, indicating the following:

1. Extent of fireproofing for each construction and fire-resistance rating.
2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
3. Minimum fireproofing thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
4. Treatment of fireproofing after application.

C. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard dimensions in size.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of fireproofing.

C. Evaluation Reports: For fireproofing, from ICC-ES.

D. Preconstruction Test Reports: For fireproofing.

E. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test for compliance with requirements for specified performance and test methods.

1. Bond Strength: Test for cohesive and adhesive strength according to ASTM E 736. Provide bond strength indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
2. Density: Test for density according to ASTM E 605. Provide density indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
3. Verify that manufacturer, through its own laboratory testing or field experience, attests that primers or coatings are compatible with fireproofing.
4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, obtain applied-fireproofing manufacturer's written instructions for corrective measures including the use of specially formulated bonding agents or primers.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is 44 deg F or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.

B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.

B. Source Limitations: Obtain fireproofing from single source.

C. Fire-Resistance Design: Indicated on Drawings, tested according to ASTM E 119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Steel members are to be considered unrestrained unless specifically noted otherwise.

D. Asbestos: Provide products containing no detectable asbestos.

2.2 SPRAYED FIRE-RESISTIVE MATERIALS

A. Sprayed Fire-Resistive Material UL P701: Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with indicated fire-resistance design, and mixed with water at Project site to form a slurry or mortar before conveyance and application.

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

a. Carboline Company; a subsidiary of RPM International.
b. Grace Construction Products; W.R. Grace & Co. -- Conn.
c. Isolatek International.
d. Pyrok, Inc.
e. Schundler Company (The).
f. Southwest Fireproofing Products Co.

2. Application: Designated for exterior use by a qualified testing agency acceptable to authorities having jurisdiction.
3. Bond Strength: Minimum 430-lbf/sq. ft. cohesive and adhesive strength based on field testing according to ASTM E 736.
4. Density: Not less than density specified in the approved fire-resistance design, according to ASTM E 605.
5. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design or ASTM E 605, whichever is thicker, but not less than 0.375 inch.
6. Combustion Characteristics: ASTM E 136.
7. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 10 or less.
b. Smoke-Developed Index: 10 or less.

8. Compressive Strength: Minimum 100 lbf/sq. in. according to ASTM E 761.
9. Corrosion Resistance: No evidence of corrosion according to ASTM E 937.
10. Deflection: No cracking, spalling, or delamination according to ASTM E 759.
11. Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E 760.
12. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. in 24 hours according to ASTM E 859.
13. Fungal Resistance: Treat products with manufacturer's standard antimicrobial formulation to result in no growth on specimens per ASTM G 21
14. Sound Absorption: NRC of 0.50 to 0.75 according to ASTM C 423 for Type A mounting according to ASTM E 795.
15. Finish: As selected by Architect from manufacturer's standard finishes

    a. Color: As selected by Architect from manufacturer's full range.

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that are compatible with fireproofing and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.

B. Substrate Primers: Primers approved by fireproofing manufacturer and complying with one or both of the following requirements:

1. Primer and substrate are identical to those tested in required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
2. Primer's bond strength in required fire-resistance design complies with specified bond strength for fireproofing and with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction, based on a series of bond tests according to ASTM E 736.

C. Bonding Agent: Product approved by fireproofing manufacturer and complying with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction.

D. Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required, according to fire-resistance designs indicated and fireproofing manufacturer's written instructions. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive fireproofing.

E. Reinforcing Fabric: Glass- or carbon-fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by fireproofing manufacturer.

F. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance design indicated; approved and provided by fireproofing manufacturer. Include pins and attachment.

G. Sealer: Transparent-drying, water-dispersible, tinted protective coating recommended in writing by fireproofing manufacturer for each fire-resistance design.

H. Topcoat: Suitable for application over applied fireproofing; of type recommended in writing by fireproofing manufacturer for each fire-resistance design.

1. Cement-Based Topcoat: Factory-mixed, cementitious hard-coat formulation for trowel or spray application over SFRM.

2. Water-Based Permeable Topcoat: Factory-mixed formulation for brush, roller, or spray application over applied SFRM. Provide application at a rate of 30 sq. ft./gal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and according to each fire-resistance design.

1. Verify that substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fireproofing with substrates under conditions of normal use or fire exposure.
2. Verify that objects penetrating fireproofing, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
3. Verify that substrates receiving fireproofing are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fireproofing application.

B. Verify that concrete work on steel deck is complete before beginning fireproofing work.

C. Verify that roof construction, installation of rooftop HVAC equipment, and other related work are complete before beginning fireproofing work.

D. Conduct tests according to fireproofing manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond.

E. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Cover other work subject to damage from fallout or overspray of fireproofing materials during application.

B. Clean substrates of substances that could impair bond of fireproofing.

C. Prime substrates where included in fire-resistance design and where recommended in writing by fireproofing manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fireproofing.

D. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fireproofing. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.3 APPLICATION

A. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, sealers, topcoats, finishing, and other materials and procedures affecting fireproofing work.

B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

C. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.

1. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.
2. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.

D. Metal Decks:

1. Do not apply fireproofing to underside of metal deck substrates until concrete topping, if any, is completed.
2. Do not apply fireproofing to underside of metal roof deck until roofing is completed; prohibit roof traffic during application and drying of fireproofing.

E. Install auxiliary materials as required, as detailed, and according to fire-resistance design and fireproofing manufacturer's written instructions for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.

F. Spray apply fireproofing to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer.

G. Extend fireproofing in full thickness over entire area of each substrate to be protected.

H. Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.

I. For applications over encapsulant materials, including lockdown (post-removal) encapsulants, apply fireproofing that differs in color from that of encapsulant over which it is applied.

J. Where sealers are used, apply products that are tinted to differentiate them from fireproofing over which they are applied.

K. Provide a uniform finish complying with description indicated for each type of fireproofing material and matching finish approved for required mockups.

L. Cure fireproofing according to fireproofing manufacturer's written instructions.

M. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.

N. Finishes: Where indicated, apply fireproofing to produce the following finishes:

1. Manufacturer's Standard Finishes: Finish according to manufacturer's written instructions for each finish selected.
2. Spray-Textured Finish: Finish left as spray applied with no further treatment.
3. Rolled, Spray-Textured Finish: Even finish produced by rolling spray-applied finish with a damp paint roller to remove drippings and excessive roughness.
4. Skip-Troweled Finish: Even leveled surface produced by troweling spray-applied finish to smooth out the texture and neaten edges.
5. Skip-Troweled Finish with Corner Beads: Even, leveled surface produced by troweling spray-applied finish to smooth out the texture, eliminate surface markings, and square off edges.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:

1. Test and inspect as required by the IBC, Subsection 1705.13, "Sprayed Fire-Resistant Materials."

B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fireproofing for the next area until test results for previously completed applications of fireproofing show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.

C. Fireproofing will be considered defective if it does not pass tests and inspections.

1. Remove and replace fireproofing that does not pass tests and inspections, and retest.
2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.

D. Prepare test and inspection reports.

3.5 CLEANING, PROTECTING, AND REPAIRING

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

B. Protect fireproofing, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fireproofing is without damage or deterioration at time of Substantial Completion.

C. As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to work of other trades.

D. Repair fireproofing damaged by other work before concealing it with other construction.

E. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

3.7 UL ASSEMBLIES & PENETRATIONS

A. Please see following pages for UL assembly details referenced in drawings.

END OF SECTION

SECTION 078400 – FIRESTOPPING

Part 1 - GENERAL

1.1 Summary

A. Furnish labor, materials, tools, equipment, and services for Firestopping, in accordance with provisions of Contract Documents.

B. Completely coordinate with work of other trades.

1.2 Quality Assurance

A. Installer Qualifications:
1. Certified, licensed or approved by firestopping manufacturer, trained to install firestop products per specified requirements.
2. Licensed by State or local authority, where applicable.
3. Shown to have successfully completed not less than five (5) comparable scale projects.

B. Provide firestop systems in compliance with following requirements:
1. Obtain firestop system for each type of penetration and construction condition from a single firestop systems manufacturer.
2. Firestop products and systems shall bear classification marking of qualified testing and inspection agency.
3. Firestopping tests, performed by qualified, testing and inspection agency.
a. UL or other agency, performing testing and follow-up inspection services for firestop systems, acceptable to local authorities having jurisdiction.
4. Existing applications for which no tested and listed classified system is available through a manufacturer:
a. Provide Engineering Judgment or Equivalent Fire Resistance Rated Assembly (EFRRA) for submittal derived from similar UL system designs or other tests approved by local authorities having jurisdiction, prior to installation.
b. Engineering judgment drawings must follow requirements set forth by International Firestop Council.
5. Inspect applied firestopping systems in accordance with International Building Code (IBC) Chapter 17.
a. Inspections shall be performed by an FMG 4991 Approved Specialty Contractor/UL Qualified Firestop Contractor and/or ASTM E2174 and ASTM E2393.
b. See Section 01 45 23.
6. FM Approved in accordance with FM Standard 4991 – Approval of Firestop Contractors.
7. UL Qualified Firestop Contractor.

C. Underwriters Laboratories, Inc. (UL):
1. UL 263, Fire Tests of Building Construction and Materials
2. UL 723, Surface Burning Characteristics of Building Materials
3. UL 1479, Fire Tests of Through Penetration Firestops
4. UL 2079, Tests for Fire Resistance of Building Joint Systems

D. ASTM International (ASTM):
1. ASTM E84 Surface Burning Characteristics of Building Materials

2. ASTM E119 Fire Tests of Building Construction and Materials
3. ASTM E136 Test Method for Behavior of Materials in a Vertical Tube Furnace at 750F
4. ASTM E814 Fire Tests of Through Penetration Fire Stops
5. ASTM E1399 Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems
6. ASTM E1966 Test Method for Fire Resistive Joint Systems
7. ASTM E2174 Standard Practice for On-site Inspection of Installed Fire Stops
8. ASTM E2307 Standard Test Method for Determining the Fire Endurance of Perimeter Fire Barrier Systems Using the Intermediate-Scale, Multi Story Test Apparatus (ISMA)
9. ASTM E2393 Standard Practice for On-site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers
10. ASTM G21 Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

E. Building Code as locally adopted and amended.

F. Underwriters Laboratories (UL) Fire Resistance Directory:
1. Through Penetration Firestop Systems (XHEZ).
2. Joint Systems (XHBN).
3. Fill, Void or Cavity Materials (XHHW).
4. Firestop Devices (XHJI).
5. Forming Materials (XHKU).
6. Wall Opening Protective Materials (CLIV).

G. National Fire Protection Association (NFPA):
1. NFPA 70: National Electrical Code
2. NFPA 101: Life Safety Code
3. NFPA 22: Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls
4. NFPA 251: Fire Tests of Building Construction and Materials

H. Firestop Contractors International Association (FCIA): MOP – FCIA Firestop Manual of Practice

I. International Firestop Council (IFC):
1. Recommended IFC Guidelines for Evaluating Firestop Engineering Judgments, latest revision.
2. Inspectors Field Pocket Guide, latest edition.

J. Identification Labels for Firestop Assemblies:
1. Follow guidelines set in Chapter 7 of International Building Code.
2. Coordinate with Section 04 22 00 and Section 09 29 00.
3. Label penetration on both sides of wall or slab.
4. Label each penetration or group of similar penetrations with a permanent label marked with the following information: a. UL system number.
   b. Rating.
   c. Products used.
   d. Installation date.
   e. Installer name.
   f. Penetration reference number unique to each location.

K. Pipe insulation shall not be removed, cut away or otherwise interrupted through wall or floor openings.
1. Provide products appropriately tested for the thickness and type of insulation utilized.

L. Cabling where frequent cable moves, add-ons, and changes are likely to occur in future:

1. Where cable trays are used:
   a. Utilize re-enterable products (e.g. removable intumescent pillows) specifically designed for retrofit.
2. Where cable trays are not used:
   Utilize fire-rated cable pathway devices.
   b. Where not practical, re-enterable products designed for retrofit may be used.

M. Protect penetrations passing through fire-resistance rated floor-ceiling assemblies contained within chase wall assemblies with products tested by being fully exposed to fire outside of chase wall.
1. Identify systems within UL Fire Resistance Directory with the words: Chase Wall Optional.

N. Fire Resistive Joint Sealant:
1. Provide flexible fire-resistive joint sealants to accommodate normal and thermal building movement without seal damage.
2. Provide fire-resistive joint sealants designed to accommodate a specific range of movement.
   a. Test in accordance with cyclic movement test criteria as outlined in: ASTM E1399, ASTM E1966 or UL 2079.
3. Provide fire-resistive joint systems subjected to an air leakage test.
   a. Conduct in accordance with UL 2079, with published L-Ratings for ambient and elevated temperatures, as evidence of ability of fire-resistive joint system to restrict movement of smoke.
4. Coordinate firestopping with acoustical sealant requirements in Section 07 92 16.

O. Subject smoke wall containment systems to air leakage test.
1. Conduct in accordance with UL 1479, with published L-Ratings for ambient and elevated temperatures, as evidence of ability of fire-resistive joint system to restrict movement of smoke.

P. System Description:
1. Through Penetration Firestop Systems for protection of penetrations through following fire-resistance rated assemblies, including both blank openings and openings containing penetrating items: a. Roof assemblies.
   b. Floor assemblies.
   c. Wall and partition assemblies.
   d. Fire-rated smoke barrier assemblies.
   e. Existing, fire and smoke-rated assemblies.
   f. Construction enclosing compartmentalized areas.
2. Fire Resistive Joint Assemblies for linear voids where fire-rated floor, roof, or wall assemblies abut one another, including following types of joints:
   a. Top and bottom of wall interface with overhead roof or floor structure: 1) Coordinate with acoustical sealant specified in Section 09 29 00.
      2) Select products to maintain acoustical, smoke and fire ratings indicated.
   b. Non-Fire Rated Expansion Joints: Specified in Section 07 95 13.
   c. Fire Rated Expansion Joints: Specified in Section 07 95 13.

Q. LEED Requirements:
1. Refer to Section 01 81 16, LEED HC v2009 Requirements, for additional performance requirements that may apply to products specified in this section.

1.3 SUBMITTALS

A. Product Data: Manufacturer's standard information indicating certification of products proposed for use on project.

B. Project Information: UL reports with illustration of systems, system numbers, temperature ratings, and products proposed for use on project.

C. Contract Closeout Information:
1. Warranty.
2. Electronic file of project firestopping documentation.
3. LEED Information: IEQ 4.1, Low-Emitting Materials, Adhesives and Sealants: Manufacturer's product data for construction adhesives and sealants including VOC content.

1.4 warranty

A. Written five (5) year warranty guaranteeing quality of installation and meeting requirements of manufacturer’s written instructions and tested systems.

Part 2 - PRODUCTS

2.1 Acceptable manufacturers

A. Firestopping:
a. Hilti, Inc.

B. Forming Materials:
a. Hilti, Inc.

2.2 MATERIALS

A. Through Penetration Firestop Systems:
1. VOC content not to exceed 250 g/L 2.
Base Products:
a. FS-ONE Intumescent Firestop Sealant.
b. CP 604 Self-leveling Firestop Sealant.
c. CP 620 Fire Foam.
d. CP 606 Flexible Firestop Sealant.
e. CP 601S Elastomeric Firestop Sealant.

B. Fire-resistive Joints:
1. VOC content not to exceed 250 g/L 2.
Base Products:
a. CFS-SP WB Firestop Joint Spray.
b. CP 601S Elastomeric Firestop Sealant.
c. CP 606 Flexible Firestop Sealant.
d. CP 604 Self-leveling Firestop Sealant.

C. Firestop Devices:
1. Factory-assembled collars lined with intumescent material sized to fit specific outside diameter of penetrating item.
2. Base Products:
a. CP 680-P Cast-in-Place Firestop Device.
b. CP 680-M Cast-in-Place Firestop Device.
c. CP 681 Tub Box Kit.
d. CFS-DID Firestop Device.

D. Intumescent Pads, Wall Opening Protective Materials:
1. Intumescent, non-curing pads or inserts for protection of electrical panels, switch and receptacle boxes, medical gas outlets and valve boxes and other items recessed in face of fire rated walls.

2. Base Product:
   a. CFS-P PA Firestop Putty Pad.
   b. CP 617 Firestop Putty Pad.
   c. Hilti Biox Insert.

E. Fire-rated Cable Pathways:
1. Usage:
   Cables passing through fire-rated floors or walls shall pass through fire-rated cable pathway devices made from an intumescent material that adjusts automatically to cable additions or subtractions.
2. Product description and requirements:
   a. Pathway device modules comprised of steel raceway and intumescent pads with adjustable smoke seal sleeve.
   b. F-Rating equal to the rating of barrier the device penetrates.
   c. Pathway devices shall be capable of allowing a 0 to 100 percent fill of cables.
   d. Size to accommodate quantity and size of electrical wires and data cables indicated plus 100 percent expansion.
   e. Provide wire devices with steel wall plates allowing for single or multiple devices ganged together without requiring additional wall structure framing.
3. Base product:
   a. CP 653 Speed Sleeve.
      1) Use in conjunction with CFS-SL GP when more than one device is required.
   b. CFS-CC Firestop Cable Collar.

F. Firestop Putty:
1. Intumescent, non-hardening, water resistant putties containing no solvents, inorganic fibers or silicone compounds.
2. Firestop putty shall be provided and installed at, but not limited to, the gap between wire, cabling, or both, exiting an open end of conduit, where conduit penetrates one or both sides of a smoke or fire rated wall assembly.
3. Base products:
   a. CP 618 Firestop Putty Stick.
   b. CFS-PL Firestop Plug.

G. Wrap Strips:
1. Single component intumescent elastomeric strips faced on both sides with a plastic film:
2. Base Products:
   a. CP 643N Firestop Collar.
   b. CP 644 Firestop Collar.
   c. CP 648E/648S Wrap Strips.

H. Firestop Blocks:
1. Re-enterable, non-curing, intumescent flexible block.
2. Base products:
   a. CFS-BL Fire Block.
   b. CFS-PL Firestop Plug.

I. Mortar:
1. Portland cement based dry-mix product formulated for mixing with water at Project site to form a non-shrinking, water-resistant, homogenous mortar.
2. Base product:
   a. CP 637 Firestop Mortar.

J. Silicone Sealants:

1. Moisture curing, single component, silicone elastomeric sealant for horizontal surfaces pourable or nonsag or vertical surface nonsag.
2. Base product:
   a. CP 601S Elastomeric Firestop Sealant.
   b. CP 604 Self LevelingSilicone Firestop Sealant.
   c. CFS-SIL SL Self Leveling Silicone Firestop Sealant.

K. Pre-formed mineral wool:
1. CP 767 Speed Strips
2. CP 777 Speed Plugs

L. Fire Sealant:
1. Single component latex or acrylic formulations that upon cure do not re-emulsify during exposure to moisture.
   a. CP 601S Elastic Firestop Sealant.
   b. CP 606 Fire Resistant Joint Filler.
   c. CP 672 Firestop Joint Spray.
   d. CFS-SP WB Firestop Joint Spray.
2. VOC content of sealants shall be no greater than 250 g/L.
3. VOC content of sealants shall be no greater than 250 g/L.
4. Adhesives and sealants shall contain no carcinogen or reproductive toxicant components present at more than 1 percent of total mass of the product as defined in the California Office of Environmental Health Hazard Assessment's (OEHHA) list entitled, Chemicals Known to the State to Cause Cancer, or the Reproductive Toxicity, Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65).

M. Composite Sheet:
1. Non-curing, re-penetrable material.
2. Base Products:
   a. CP 675T Firestop Board.
   b. CFS-BL FireBlock.

N. Forming Materials:
1. Materials listed as components in laboratory-approved designs.
2. Mineral Wool:
   a. Base Product:CP 767 Speed Strip
   b. Similar product specifically named as components in laboratory-approved designs.

O. Perimeter Fire Containment: Specified in Section 07 84 53.

P. Acoustical Sealant: Specified in Section 07 92 16.

2.3 THROUGH PENETRATION FIRESTOP SYSTEMS

A. General:
1. Schedules below identify requirements for acceptable through penetration firestop systems based on barrier type, fire-resistive rating, and penetrant type. Each system must comply with building code and fire code as locally adopted and amended.
2. Requirements for single-membrane penetrations and through penetration firestops are identical. Unless otherwise noted, penetrants which pass through a single membrane, shall be treated the same as if it passed through the entire fire-resistive assembly.
3. Select each firestop system based on actual field conditions, including penetration type, shape, size, quantities and physical position within opening.

4. Refer to Plans for indication of the required ratings of fire-resistive wall, floor, and roof assemblies.
5. Indicated ratings are minimum and may be exceeded.
6. Firestop Assemblies at Fire-Rated Walls:
   a. The minimum Fire (F) Rating for Firestop assemblies in walls shall equal that of the wall, but not less than 1-HR.
   b. The minimum Temperature (T) Rating of Firestop assemblies in walls may equal zero.
   c. Smoke Barrier: In addition to (F) Rating, (L) Rating of maximum 5 CFM per SF.
   d. Non-rated walls and Smoke-Partitions with no fire-resistive requirement: Assembly with (L) rating.
7. Firestop assemblies at fire-rated floors and roofs:
   Minimum Fire (F) and Temperature (T) Ratings of Firestop assemblies used in floors or roof shall equal hourly rating of floor or roof being penetrated, but not less than 1-HR.
   1) Exception 1: The T-rating may equal zero when portion of penetration, above or below floor, is contained within a wall.
   2) Exception 2: Firestops are not required for floor penetrations within a 2-hour rated shaft enclosure.

B. Voids in wall with no penetrations:
1. Fill with approved through penetration firestopping system.
2. Contractor's option: Patch void in wall with like construction.

C. Penetrating Ducts with Dampers:
1. Utilize only firestop materials which are included in damper's classification.
2. Do not install firestop systems that hamper performance of fire dampers.

D. Cable Trays and similar devices:
1. Provide re-enterable products specifically designed for removal and re-installation at openings within walls and floors designed to accommodate voice, data and video cabling.

E. Electrical panels and devices, medical gas outlets and valve boxes, film illuminators, and other items recessed in to face of rated walls:
1. Where electrical devices are placed on opposite sides of wall, and are less than 24 IN apart measured horizontally, install intumescent pads over back of devices in approved manner or maintain continuity of rated barrier within wall cavity surrounding recessed item.

2.4 FIRE-RESISTIVE JOINT ASSEMBLIES – GENERAL

A. General:
1. Where joint will be exposed to elements, fire-resistive joint sealant must be approved by manufacturer for use in exterior applications and shall comply with ASTM C920.

B. Head-of-Wall Assemblies:
1. General:
   a. Use at top of fire-rated and smoke barrier walls and partitions where they abut floor and roof structures above.
   b. Select systems with D designation, rated for dynamic movement capability.
   c. Select systems that can accommodate deflection of structure above.
   d. Maximum Leakage for Fire-resistive Joints in Smoke Barriers: 5 CFM or less per linear foot as tested in accordance with UL 2079.
   e. Seal non-fire-rated sound-control walls and smoke partitions with acoustical sealant as specified in Section 07 92 16.

2. Minimum F and T ratings:
    a. The minimum fire rating for firestop assemblies in walls shall equal that of wall, but not less than 1-HR.
    b. The minimum temperature rating of firestop assemblies in walls may equal zero.
3. Acceptable Systems:
    a. Metal stud and drywall partitions: Select system from UL HW-D-0000 Series.
    b. Concrete and Masonry Walls: Select system from UL HW-D-1000 Series.

Part 3 - EXECUTION

3.1 PREPARATION

A. Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.

B. Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellents, and any other substances that may inhibit optimum adhesion.

C. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.

D. Do not proceed until unsatisfactory conditions have been corrected.

3.2 Installation

A. General:
1. Install firestop systems in accordance with manufacturer's instructions and conditions of testing and classification as specified in UL or other acceptable thirdparty testing agency listing.
2. Penetrations through fire-resistive floor assemblies shall be sealed with firestop system providing minimum Class 1 W-rating as tested in accordance with UL 1479 and ensure air and water resistant seal.
3. Protect materials from damage on surfaces subjected to traffic.

B. Identification Labels:
1. Identify each firestop assembly as defined in Quality Assurance.
2. Do not locate identification labels, tags, or both, on finished surfaces or where exposed to view by public.

3.3 FIELD QUALITY CONTROL

A. Owner shall engage a qualified independent inspection agency to inspect firestop systems in accordance with ASTM E2174, Standard Practice for On-site Inspection of Installed Fire Stops, and ASTM E2393, Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.

B. Construct mock-up on-site to include typical through penetration and fire-resistive joint applications for project.

C. Maintain areas of work accessible until inspection by authorities having jurisdiction.

D. Where deficiencies are found, repair or replace assemblies to comply with requirements.

3.4 ADJUSTING AND CLEANING

A. Remove equipment, materials and debris, leaving area in undamaged, clean condition.

B. Clean surfaces adjacent to sealed openings free of excess materials and soiling as work progresses.

C. Perform patching and repair of firestopping systems damaged by other trades.

END OF SECTION

ONLINE CERTIFICATIONS DIRECTORY

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XHEZ.C-AJ-1140
Through-penetration Firestop Systems

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Design/System/Construction/Assembly Usage Disclaimer

- Authorities Having Jurisdiction should be consulted in all cases as to the particular requirements covering the installation and use of UL Certified products, equipment, system, devices, and materials.
- Authorities Having Jurisdiction should be consulted before construction.
- Fire resistance assemblies and products are developed by the design submitter and have been investigated by UL for compliance with applicable requirements. The published information cannot always address every construction nuance encountered in the field.
- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.
- Only products which bear UL's Mark are considered Certified.

XHEZ - Through-penetration Firestop Systems

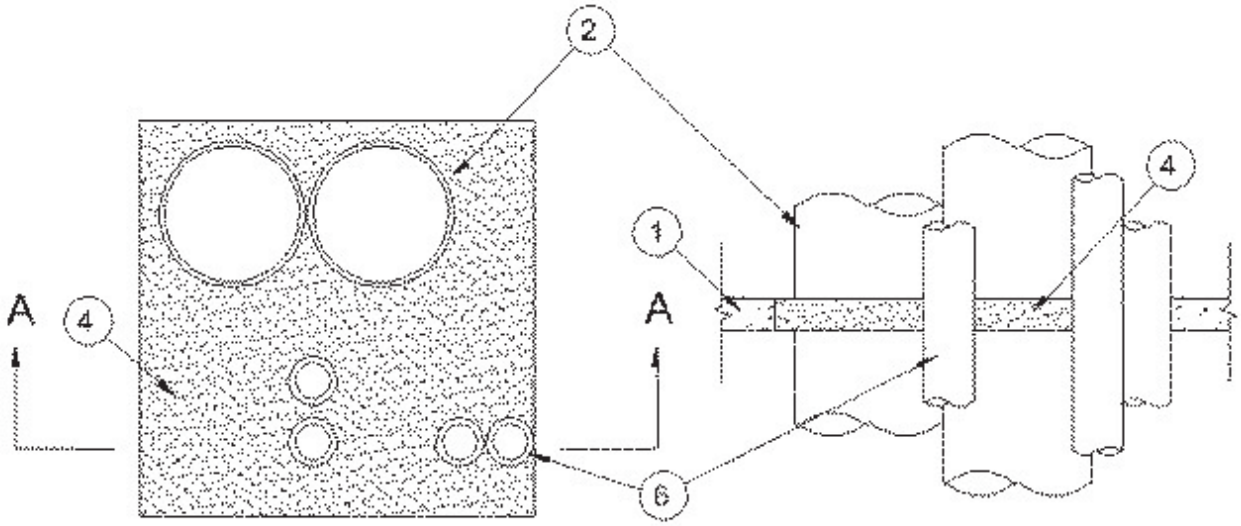
See General Information for Through-penetration Firestop Systems

System No. C-AJ-1140

March 19, 2012

F Rating — 3 Hr

T Rating — 0 Hr



SECTION A-A

1. **Floor or Wall Assembly —** Min 2-1/2 in. (63 mm) thick reinforced lightweight or normal weight (100-150 pcf or1600-2400 kg/m^3) concrete. Wall may also be constructed of any UL Classified **Concrete Blocks ***. Max area of opening is 1024 sq in. (.66 sq m) with max dimension of 32 in. (81.3 cm).

See **Concrete Blocks** (CAZT) category in the Fire Resistance Directory for names of manufacturers.

2. **Through Penetrants —** One or more penetrants to be installed in opening. Min clearance between pipes, conduits or tubing is 0 in. (0 mm). (point contact). Min clearance between pipes, conduit or tubing and periphery of through opening is 1 in. (25 mm). Min clearance between pipes, conduit or tubing and periphery of any single surface of through

opening is 0 in. (point contact). Pipe, conduit or tubing to be rigidly supported on both sides of floor or wall assembly. The following types and sizes of metallic pipes, conduits or tubing may be used:

A. **Steel Pipe —** Nom 12 in. (305 mm) diam (or smaller) Schedule 10 (or heavier) steel pipe.

B. **Conduit —** Nom 4 in. (102 mm) diam (or smaller) steel electrical metallic tubing or steel conduit.

C. **Copper Tubing —** Nom 4 in. (102 mm) diam (or smaller) Type L (or heavier) copper tubing.

D. **Copper Pipe —** Nom 4 in. (102 mm) diam (or smaller) Regular (or heavier) copper pipe.

3. **Forms —** (Not Shown) — Used as a form to prevent leakage of fill material during installation. Forms to be a rigid sheet material, cut to fit the contour of the penetrating item and positioned as required to accommodate the required thickness of fill material. Forms may be removed after fill material has cured.

4. **Firestop System —** The details of the firestop system shall be as follows:

A. **Packing Material —** (Optional, Not Shown) - For floors greater than 2-1/2 in. (63 mm) thick, mineral wool batt insulation firmly packed into opening as a permanent or temporary form and recessed from the top surface of floor to accommodate the required thickness of the fill material.

B. **Fill, Void or Cavity Material* — Mortar —** Min 2-1/2 in. (63 mm) thickness of fill material applied within the annulus. Fill material is mixed at a rate of 2.5 parts dry mix to one part water by weight in accordance with the installation instructions supplied with fill material.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — Type CP636 or CP637

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**

Last Updated on 2012-03-19

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ONLINE CERTIFICATIONS DIRECTORY

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Through-penetration Firestop Systems

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Design/System/Construction/Assembly Usage Disclaimer

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- Authorities Having Jurisdiction should be consulted before construction.
- Fire resistance assemblies and products are developed by the design submitter and have been investigated by UL for compliance with applicable requirements. The published information cannot always address every construction nuance encountered in the field.
- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.
- Only products which bear UL's Mark are considered Certified.

XHEZ - Through-penetration Firestop Systems

XHEZ7 - Through-penetration Firestop Systems Certified for Canada

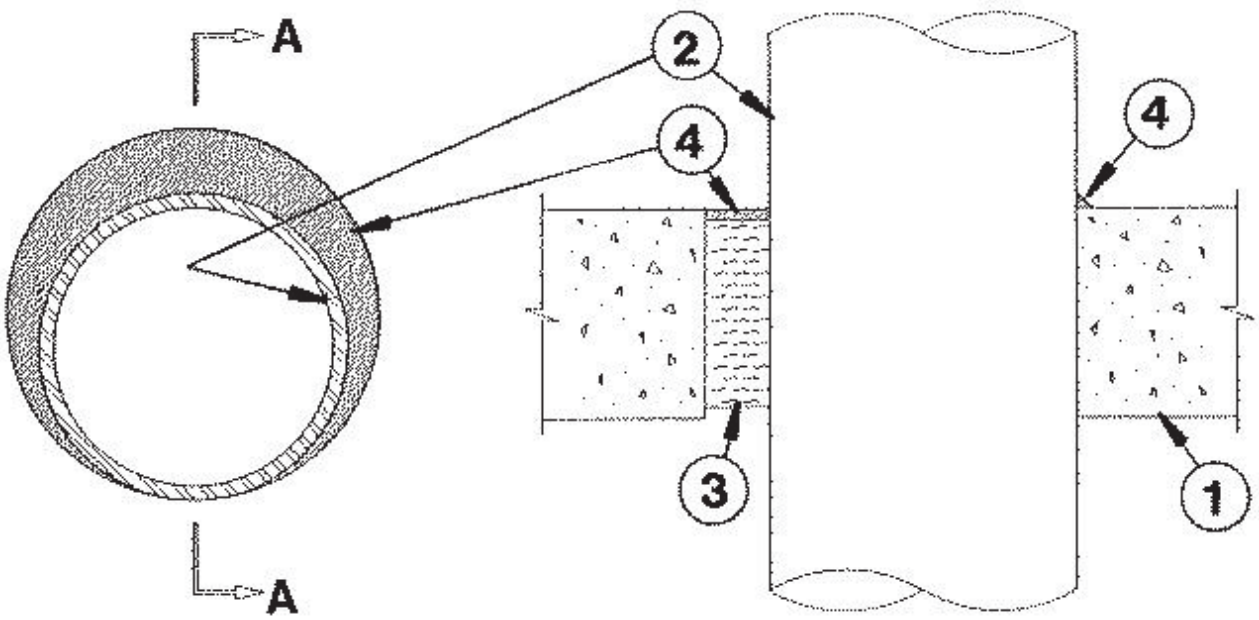
See General Information for Through-penetration Firestop Systems

See General Information for Through-penetration Firestop Systems Certified for Canada

System No. C-AJ-1149

February 20, 2015

ANSI/UL1479 (ASTM E814)	CAN/ULC S115
F Rating — 2 Hr	F Rating —2 Hr
T Rating — 0 Hr	FT Rating — 0 Hr
L Rating At Ambient — Less Than 1 CFM/sq ft	FH Rating — 2 Hr
L Rating At 400 F — 4 CFM/sq ft	FTH Rating — 0 Hr
W Rating — Class 1 (See Item 4)	L Rating At Ambient — Less Than 1 CFM/sq ft
	L Rating At 400 F — 4 CFM/sq ft



SECTION A-A

1. **Floor or Wall Assembly —** Min 4-1/2 in. (114 mm) thick reinforced lightweight or normal weight (100-150 pcf or 1600-2400 kg/m^3) concrete. Wall may also be constructed of any UL Classified **Concrete Blocks ***. Max diam of opening is 12 in. (305 mm).

See **Concrete Blocks** (CAZT) category in the Fire Resistance Directory for names of manufacturers.

2. **Through Penetrants —** One metallic pipe, conduit or tubing to be installed within the firestop system. Pipe, conduit or tubing to be rigidly supported on both sides of floor or wall assembly. The annular space shall be 0 in. (point contact) to max 1-1/4 in. (32 mm). The following types and sizes of metallic pipes, conduits or tubing may be used:

A. **Steel Pipe —** Nom 10 in. (254 mm) diam (or smaller) Schedule 10 (or heavier) steel pipe.

B. **Iron Pipe —** Nom 10 in. (254 mm) diam (or smaller) cast or ductile iron pipe.

C. **Conduit —** Nom 4 in. (102 mm) diam (or smaller) steel electrical metallic tubing or steel conduit.

D. **Copper Tubing —** Nom 4 in. (102 mm) diam (or smaller) Type L (or heavier) copper tubing.

E. **Copper Pipe —** Nom 4 in. (102 in.) diam (or smaller) Regular (or heavier) copper pipe.

3. **Packing Material —** Min 3 in. (76 mm) thickness of min 4 pcf (64 kg/m^3) mineral wool batt insulation for nom 4 in. diam (and smaller) pipes, conduits or tubings and a min 4 in. (102 mm) thickness of min 4 pcf (64 kg/m^3) mineral wool batt insulation for pipe greater than nom 4 in. diam, firmly packed into opening as a permanent form. Packing material to be recessed from top surface of floor or from both surfaces of wall to accommodate the required thickness of fill material.

4. **Fill, Void or Cavity Material* — Sealant —** Min 1/2 in. (13 mm) thickness of fill material applied within the annulus, flush with the top surface of floor or both surfaces of wall. At the point of contact location between pipe and concrete, a min 1/2 in. (13 mm) diam bead of fill material shall be applied at the concrete/pipe interface on the top surface of floor and on both surfaces of wall. **W Rating applies only when CFS-S SIL GG, CFS-S SIL SL (floors only), CP601S, CP604 sealant or FS-ONE MAX Intumescent Sealant is used. For W Rating when FS-ONE MAX is used, packing material to be a min 4 in. (102 mm) thickness of min 4 pcf (64 kg/m^3) mineral wool batt insulation.**

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — CP601S, CP604, CFS-S SIL GG, CFS-S SIL SL (floors only), CP606 or FS-ONE Sealant or FS-ONE MAX Intumescent Sealant.

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ONLINE CERTIFICATIONS DIRECTORY

System No. C-AJ-1155
XHEZ.C-AJ-1155
Through-penetration Firestop Systems

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XHEZ - Through-penetration Firestop Systems

XHEZ7 - Through-penetration Firestop Systems Certified for Canada

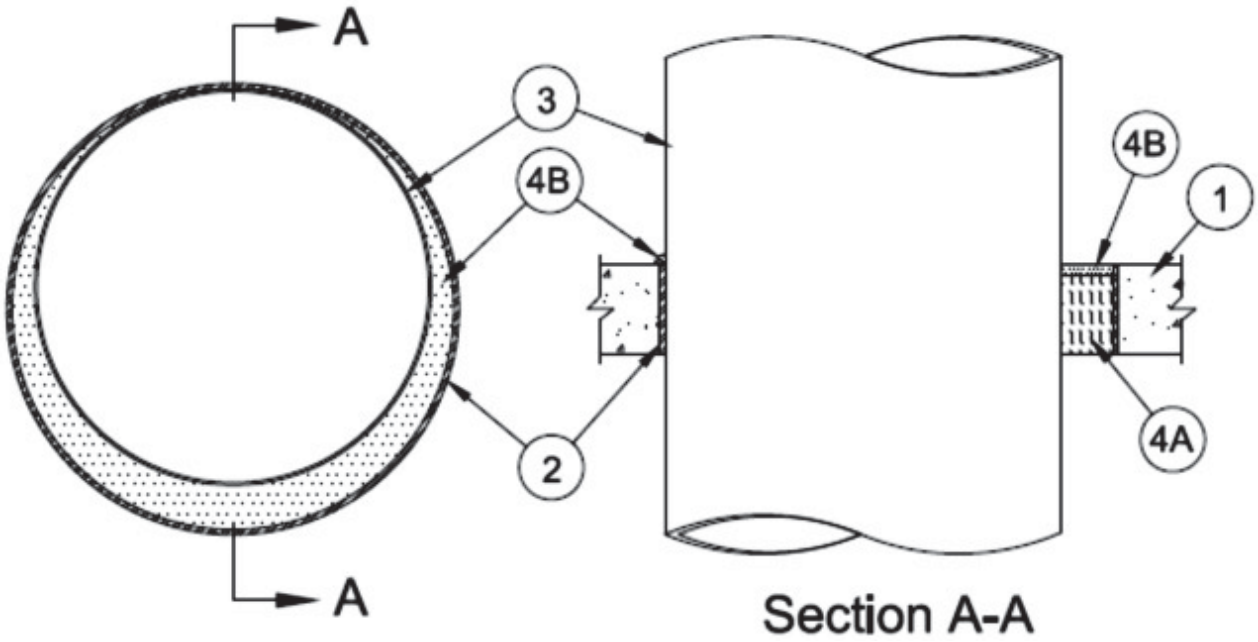
See General Information for Through-penetration Firestop Systems

See General Information for Through-penetration Firestop Systems Certified for Canada

System No. C-AJ-1155

February 20, 2015

ANSI/UL1479 (ASTM E814)	CAN/ULC S115
F Rating — 2 and 3 Hr (See Item 3)	F Rating — 2 and 3 Hr (See Item 3)
T Rating —0 Hr	FT Rating — 0 Hr
L Rating At Ambient — Less Than 1 CFM/sq ft	FH Rating — 2 and 3 Hr (See Item 3)
L Rating At 400 F — 4 CFM/sq ft	FTH Rating — 0 Hr
W Rating — Class 1 (See Item 4)	L Rating At Ambient — Less Than 1 CFM/sq ft
	L Rating At 400 F — 4 CFM/sq ft



1. **Floor or Wall Assembly —** Min 4-1/2 in. (114 mm) thick reinforced lightweight or normal weight (100-150 pcf or 1600-2400 kg/m^3) concrete. Wall may also be constructed of any UL Classified **Concrete Blocks***. Max diam of opening is 32 in. (813 mm).

See **Concrete Blocks** (CAZT) category in Fire Resistance Directory for names of manufacturers.

2. **Metallic Sleeve (Optional) —** Nom 32 in. (813 mm) diam (or smaller) Schedule 40 (or heavier) steel pipe cast or grouted into floor or wall assembly, flush with floor or wall assembly.

3. **Through Penetrants —** One metallic pipe or tubing to be installed either concentrically or eccentrically within the firestop system. Pipe or tubing to be rigidly supported on both sides of floor or wall assembly. The annular space shall be min 0 in. (point contact) to max 12 in. (305 mm). **When maximum annular space exceeds 2-1/4 in. (57 mm) the F Rating is 2 hr.** The following types and sizes of metallic pipes or tubing may be used:

A. **Steel Pipe —** Nom 20 in. (508 mm) diam (or smaller) Schedule 10 (or heavier) steel pipe.

B. **Iron Pipe —** Nom 20 in. (508 mm) diam (or smaller) cast or ductile iron pipe.

C. **Conduit —** Nom 4 in. (102 mm) diam (or smaller) steel electrical metallic tubing or nom 6 in. (152 mm) diam (or smaller) steel electrical metallic tubing or nom 6 in. (152 mm) diam (or smaller) steel conduit.

D. **Copper Tubing —** Nom 6 in. (152 mm) diam (or smaller) Type L (or heavier) copper tubing.

E. **Copper Pipe —** Nom 6 in. (152 mm) diam (or smaller) Regular (or heavier) copper pipe

4. **Firestop System —** The firestop system shall consist of the following:

A. **Packing Material —** Min 4 in. (102 mm) thickness of min 4 pcf (64 kg/m^3) mineral wool batt insulation firmly packed into opening as a permanent form. Packing material to be recessed from top end of sleeve for floors or from both ends of sleeve for walls to accommodate the required thickness of fill material.

B. **Fill, Void or Cavity Material* — Sealant —** Min 1/2 in. (13 mm) thickness of fill material applied within the annulus, flush with the top end of the sleeve for floors, or with both ends of the sleeve for walls. Min 1/2 in. (13 mm) thick bead of all material to be installed around pipe at interface of sleeve for point contact installations. **W Rating applies only when FS-ONE MAX Intumescent Sealant is used. For the W Rating, max annular space is 1-7/8 in. (48 mm) and an additional film of sealant shall be applied over the sleeve (when used) lapping at least 1/2 in. (13 mm) onto top surface of floor or both surfaces of wall.**

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — FS-ONE Sealant or FS-ONE MAX Intumescent Sealant

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ONLINE CERTIFICATIONS DIRECTORY

System No. C-AJ-1276
XHEZ.C-AJ-1276
Through-penetration Firestop Systems

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XHEZ7 - Through-penetration Firestop Systems Certified for Canada

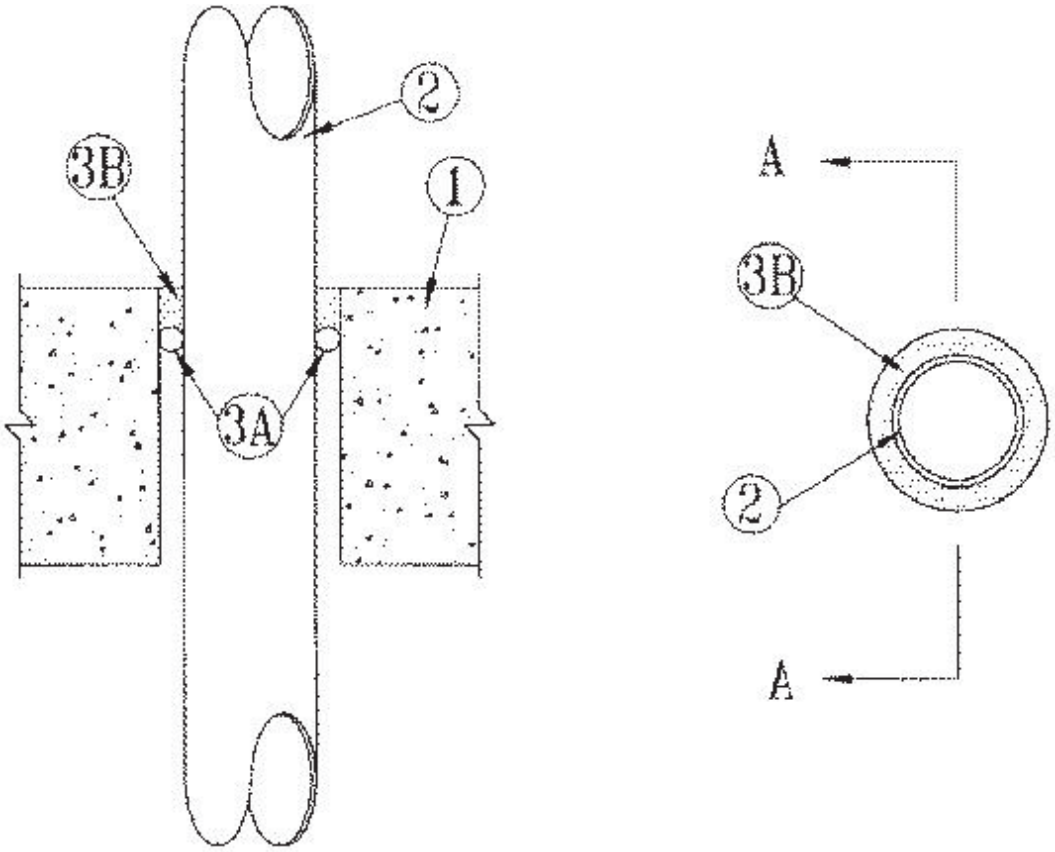
See General Information for Through-penetration Firestop Systems

See General Information for Through-penetration Firestop Systems Certified for Canada

System No. C-AJ-1276

April 20, 2012

ANSI/UL1479 (ASTM E814)	CAN/ULC S115
F Rating — 3 Hr	F Rating — 3 Hr
T Rating — 0 Hr	FT Rating — 0 Hr
	FH Rating — 3 Hr
	FTH Rating — 0 Hr



SECTION A-A

1. **Floor or Wall Assembly —** Min 4-1/2 in. (114 mm) thick reinforced lightweight or normal weight (100-150 pcf or 1600-2400 kg/m^3) concrete. Wall may also be constructed of any UL Classified **Concrete Blocks***. Max diam of opening is 6 in. (152 mm).

See **Concrete Blocks** (CAZT) category in the Fire Resistance Directory for names of manufacturers.

2. **Through Penetrants —** One metallic pipe, conduit or tubing to be centered within the firestop system. A nom annular space of 3/4 in. (19 mm) is required within the firestop system. Pipe, conduit or tubing to be rigidly supported on both sides of floor or wall assembly. The following types and sizes of metallic pipes, conduits or tubing may be used:

A. **Steel Pipe —** Nom 4 in. (102 mm) diam (or smaller) Schedule 10 (or heavier) steel pipe.

B. **Conduit —** Nom 4 in. (102 mm) diam (or smaller) steel electrical metallic tubing or steel conduit.

3. **Firestop System —** The firestop system shall consist of the following:

A. **Packing or Forming Materials —** Optional — One of the following packing or forming materials may be used:

A1. **Foam Backer Rod —** Foam backer rod tightly packed into the opening as a permanent form. Packing material to be recessed from the top surface of floor or both surfaces of wall as required to accommodate the required thickness of putty.

A2. **Mineral Wool Batt Insulation —** Min 4 pcf (64 kg/m^3), tightly packed into the opening as a permanent form. Packing material to be recessed from the top surface of floor or both surfaces of wall as required to accommodate the required thickness of putty.

A3. **Forming Material* —** Forming material to be foamed into the opening as a permanent form. Forming material to be recessed from the top surface of floor or both surfaces of wall as required to accommodate the required thickness of putty.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — CF812 or CF-AS CJP Foam Sealant

B. **Fill, Void or Cavity Material* — Putty —** Min 1 in. (25 mm) thickness of putty applied within the annulus, flush with top surface of floor or with both surfaces of wall.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — CP 618 Firestop Putty Stick

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System No. C-AJ-1277
XHEZ.C-AJ-1277
Through-penetration Firestop Systems

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XHEZ7 - Through-penetration Firestop Systems Certified for Canada

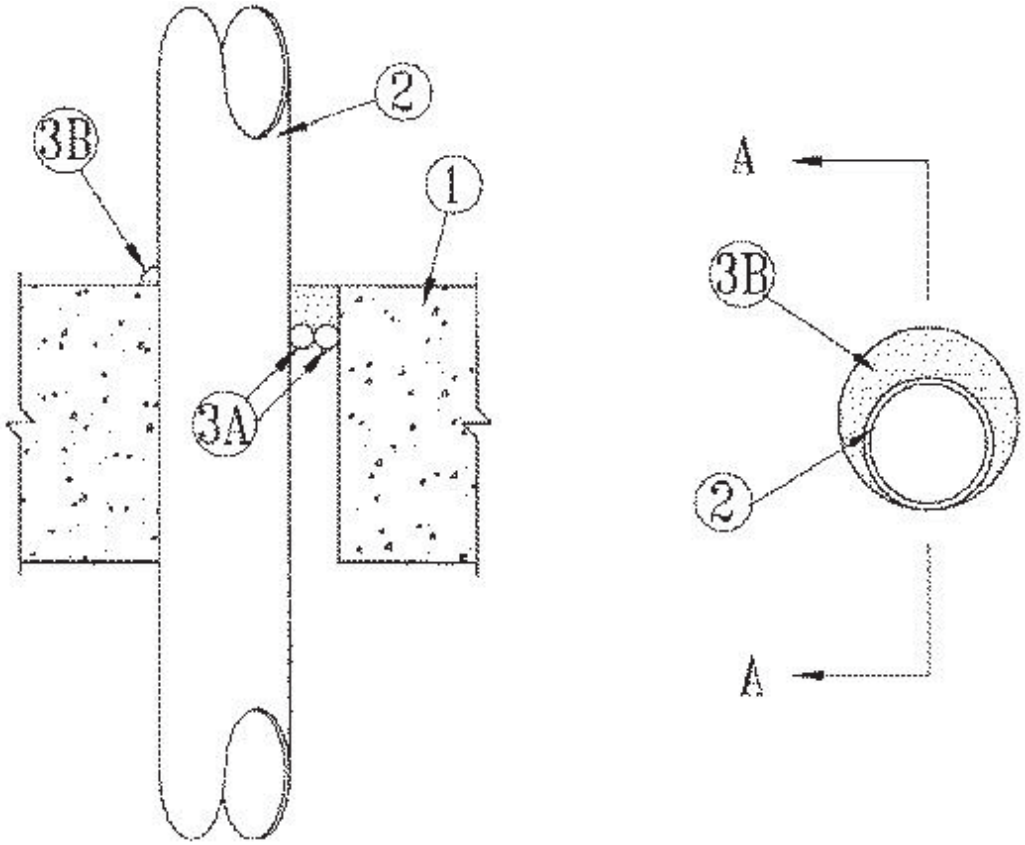
See General Information for Through-penetration Firestop Systems

See General Information for Through-penetration Firestop Systems Certified for Canada

System No. C-AJ-1277

April 20, 2012

ANSI/UL1479 (ASTM E814)	CAN/ULC S115
F Rating — 3 Hr	F Rating — 3 Hr
T Rating — 1/2 Hr	FT Rating — 1/2 Hr
	FH Rating — 3 Hr
	FTH Rating — 1/2 Hr



SECTION A–A

1. **Floor or Wall Assembly —** Min 4-1/2 in. (114 mm) thick reinforced lightweight or normal weight (100-150 pcf or 1600-2400 kg/m^3) concrete. Wall may also be constructed of any UL Classified **Concrete Blocks*.** Max diam of opening is 4 in. (102 mm).

See **Concrete Blocks** (CAZT) category in the Fire Resistance Directory for names of manufacturers.

2. **Through Penetrants —** One metallic pipe, conduit or tubing to be installed either concentrically or eccentrically within the firestop system. The annular space shall be min 0 in. (point contact) to max 1-13/16 in. (46 mm). Pipe or conduit to be rigidly supported on both sides of floor or wall assembly. The following types and sizes of metallic pipes or conduits may be used:

A. **Steel Pipe —** Nom 2 in. (51 mm) diam (or smaller) Schedule 40 (or heavier) steel pipe.

B. **Iron Pipe —** Nom 2 in. (51 mm) diam (or smaller) cast or ductile iron pipe.

C. **Conduit —** Nom 2 in. (51 mm) diam (or smaller) steel electrical metallic tubing or steel conduit.

3. **Firestop System —** The firestop system shall consist of the following:

A. **Packing or Forming Materials —** One of the following packing or forming materials may be used:

A1. **Foam Backer Rod —** Tightly packed into the opening as a permanent form. Packing material to be recessed from the top surface of floor or both surfaces of wall as required to accommodate the required thickness of putty.

A2. **Mineral Wool Batt Insulation —** Min 4 pcf (64 kg/m^3), tightly packed into the opening as a permanent form. Packing material to be recessed from the top surface of floor or both surfaces of wall as required to accommodate the required thickness of putty.

A3. **Forming Materials* —** Forming material to be foamed into the opening as a permanent form. Forming material to be recessed from the top surface of floor or both surfaces of wall as required to accommodate the required thickness of putty.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — CF812 or CF-AS CJP Foam Sealant

B. **Fill, Void or Cavity Material* — Putty —** Min 3/4 in. (19 mm) thickness of putty applied within the annulus, flush with top surface of floor or with both surfaces of wall. At the point contact location between pipe and concrete, a min 1/4 in. (6 mm) diam bead of fill material shall be applied at the concrete/pipe interface on the top surface of floor and on both surfaces

of wall.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — CP 618 Firestop Putty Stick

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System No. C-AJ-1278
XHEZ.C-AJ-1278
Through-penetration Firestop Systems

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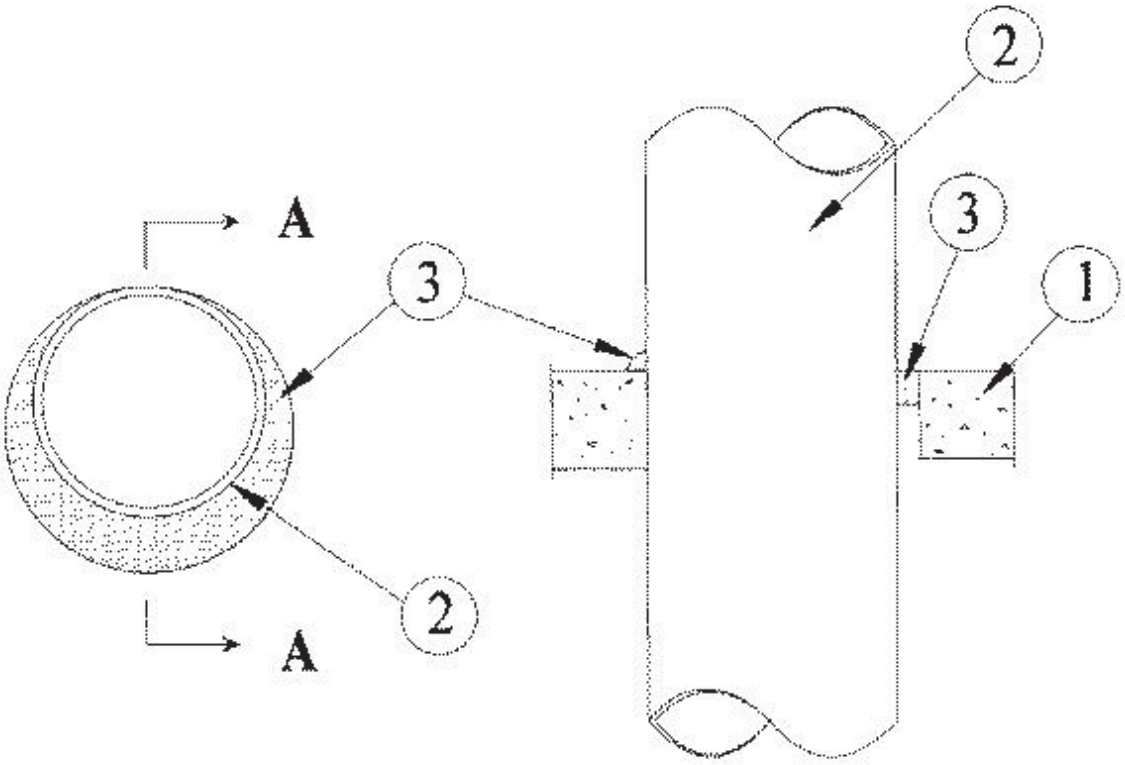
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See General Information for Through-penetration Firestop Systems Certified for Canada

System No. C-AJ-1278

January 07, 2015

ANSI/UL1479 (ASTM E814)	CAN/ULC S115
F Rating - 3 Hr	F Rating - 3 Hr
T Rating - 0 Hr	FT Rating - 0 Hr
	FH Rating - 3 Hr
	FTH Rating - 0 Hr



SECTION A-A

1. **Floor or Wall assembly —** Minimum 4-1/2 in. (114 mm) thick reinforced lightweight or normal weight (100-150 pcf or 1600-2400 kg/m^3) concrete. Wall may also be constructed of any UL Classified **Concrete Blocks*.** Maximum diameter of opening is 30-7/8 in. (784 mm).

See **Concrete Blocks** (CAZT) category in the Fire Resistance Directory for names of manufacturers.

2. **Through-Penetrant —** One metallic pipe or conduit to be installed either concentrically or eccentrically within the firestop system. The annular space between pipe or conduit and periphery of opening shall be minimum 0 in. to maximum 7/8 in. (22 mm). Pipe or conduit to be rigidly supported on both sides of floor or wall assembly. The following types and sizes of metallic pipes or conduits may be used:

A. **Steel Pipe —** Nominally 30 in. (762 mm) diameter (or smaller) Schedule 10 (or heavier) steel pipe.

B. **Copper Pipe —** Nominally 6 in. (152 mm) diameter (or smaller) Regular (or heavier) copper pipe.

C. **Copper Tubing —** Nominally 6 in. (152 mm) diameter (or smaller) Type L (or heavier) copper tubing.

D. **Conduit —** Nominally 6 in. (152 mm) diameter (or smaller) steel conduit.

E. **Conduit —** Nominally 4 in. (102 mm) diameter (or smaller) steel electrical metallic tubing (EMT).

3. **Fill, Void or Cavity Material* — Sealant —** Minimum 1/2 in. (13 mm) thickness of fill material applied within the annulus, flush with top surface of floor or with both surfaces of wall. At the point contact location between pipe and concrete, a minimum 1/4 in. (6 mm) diameter bead of fill material shall be applied at the concrete/pipe interface on the top surface of floor and on both surfaces of wall.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — FS-ONE Sealant or FS-ONE MAX Intumescent Sealant

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System No. C-AJ-2118
XHEZ.C-AJ-2118
Through-penetration Firestop Systems

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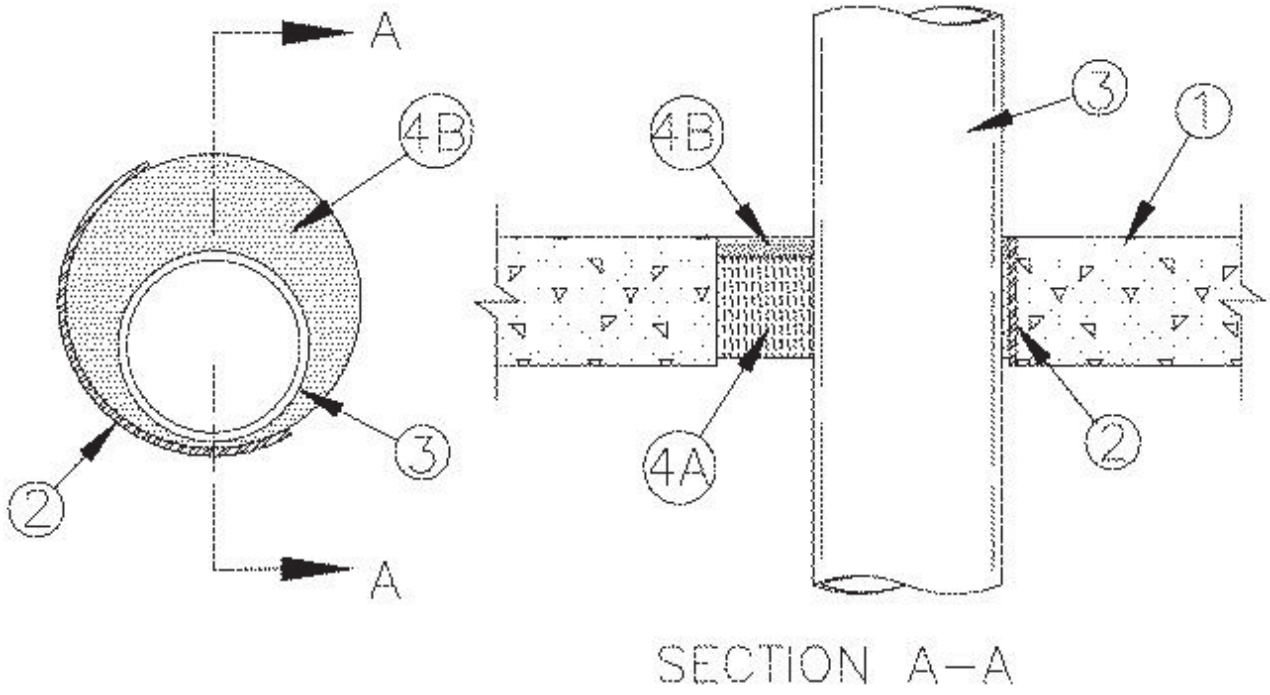
January 27, 2015

F Rating — 3 Hr

T Rating — 0 Hr

L Rating At Ambient — Less Than 1 CFM/sq ft

L Rating At 400 F — 4 CFM/sq ft



1. **Floor or Wall Assembly —** Min 4-1/2 in. (114 mm) thick reinforced lightweight or normal weight (100-150 pcf or 1600-2400 kg/m^3) concrete floor or min 5 in. (127 mm) thick reinforced lightweight or normal weight concrete wall. Wall may also be constructed of any UL Classified **Concrete Blocks*.** Max diam of opening is 10 in. (254 mm).

See **Concrete Blocks** (CAZT) category in the Fire Resistance Directory for names of manufacturers.

2. **Metallic Sleeve —** (Optional) — Nom 10 in. (254 mm) diam (or smaller) Sch 10 (or heavier) steel pipe cast or grouted into floor or wall assembly, flush with floor or wall surfaces.

3. **Through-Penetrants* — Glass Pipe —** Nom 6 in. (152 mm) diam (or smaller) glass pipe used for use in closed (process or supply) or vented (drain, waste or vent) piping systems. One pipe to be installed either concentrically or eccentrically within the firestop system. The annular space shall be min 1/4 in. (6 mm) to max 3-1/2 in. (89 mm). Pipe couplings to be located min 12 in. (305 mm) from floor or wall surfaces. Pipe to be rigidly supported on both sides of floor or wall assembly.

4. **Firestop System —** The firestop system shall consist of the following:

A. **Packing Material —** Min 4.0 pcf (64 kg/m^3) mineral wool batt insulation installed in through opening as a permanent form. Pieces of batt cut to min width of 3-1/2 in. (89 mm) and installed edge-first into opening such that batt sections are tightly-compressed in thickness and such that the compressed batt sections are recessed from top surface of floor or from both surfaces of wall as required to accommodate the required thickness of fill material.

B. **Fill, Void or Cavity Material* — Sealant —** Min 3/4 in. (19 mm) thickness of fill material applied within the annulus, flush with top surface of floor or with both surfaces of wall.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — FS-One Sealant or FS-ONE MAX Intumescent Sealant

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ONLINE CERTIFICATIONS DIRECTORY

System No. C-AJ-2141
XHEZ.C-AJ-2141
Through-penetration Firestop Systems

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XHEZ - Through-penetration Firestop Systems

See General Information for Through-penetration Firestop Systems

System No. C-AJ-2141

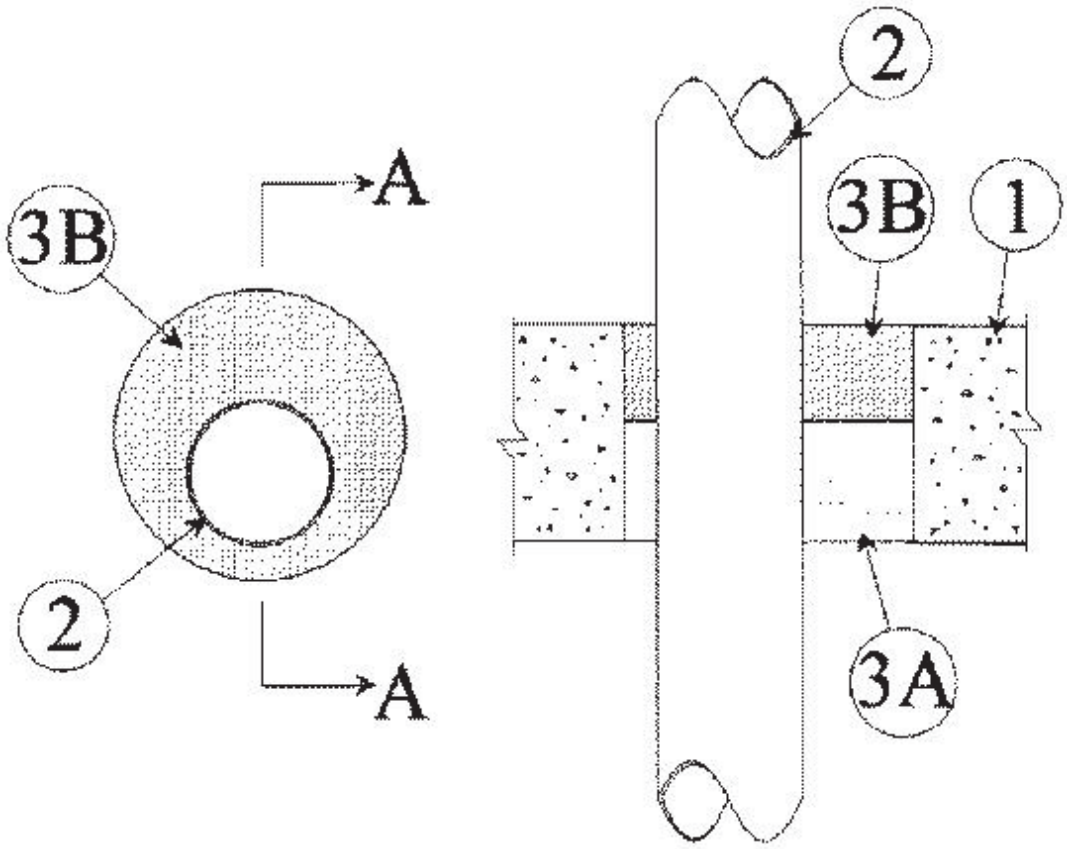
January 09, 2015

F Rating — 3 Hr

T Rating — 2 Hr

L Rating At Ambient — Less Than 1 CFM/Sq Ft

L Rating At 400 F — 4 CFM/Sq ft



SECTION A-A

1. **Floor or Wall Assembly —** Min 4-1/2 in. (114 mm) thick reinforced lightweight or normal weight (100-150 pcf or 1600-2400 kg/m^3) concrete. Wall may also be constructed of any UL Classified Concrete Blocks*. Max diam of opening is 6 in. (152 mm).

See **Concrete Blocks*** (CAZT) category in the Fire Resistance Directory for names of manufacturers.

2. **Through Penetrants —** One nonmetallic pipe or conduit to be installed either concentrically or eccentrically within the firestop system. The annular space between the pipe or conduit and the periphery of the opening shall be min 1/2 in. (13 mm) to max 2 in. (51 mm). The pipe or conduit to be rigidly supported on both sides of floor or wall. The following types and sizes of pipes or conduits may be used:

A. **Polyvinyl Chloride (PVC) Pipe —** Nom 3 in. (76 mm) diam (or smaller) Schedule 40 PVC pipe for use in closed (process or supply) piping systems.

B. **Chlorinated Polyvinyl Chloride (CPVC) Pipe —** Nom 3 in. (76 mm) diam (or smaller) SDR 17 CPVC pipe for use in closed (process or supply) piping systems.

3. **Firestop System —** The firestop system shall consist of the following:

A. **Forming Material* —** Min 2-1/2 in. (64 mm) thickness of forming material foamed into opening as a permanent form. Forming material to be recessed from top surface of floor or from both surfaces of wall as required to accommodate the required thickness of fill material.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — CF812 or CF-AS CJP Foam Sealant

B. **Fill, Void or Cavity Material* — Sealant —** Min 2 in. (51 mm) thickness of fill material applied with annulus flush with top surface of floor or within both surfaces of wall.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — FS-ONE Sealant or FS-ONE MAX Intumescent Sealant

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ONLINE CERTIFICATIONS DIRECTORY

System No. C-AJ-2217
XHEZ.C-AJ-2217
Through-penetration Firestop Systems

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XHEZ - Through-penetration Firestop Systems

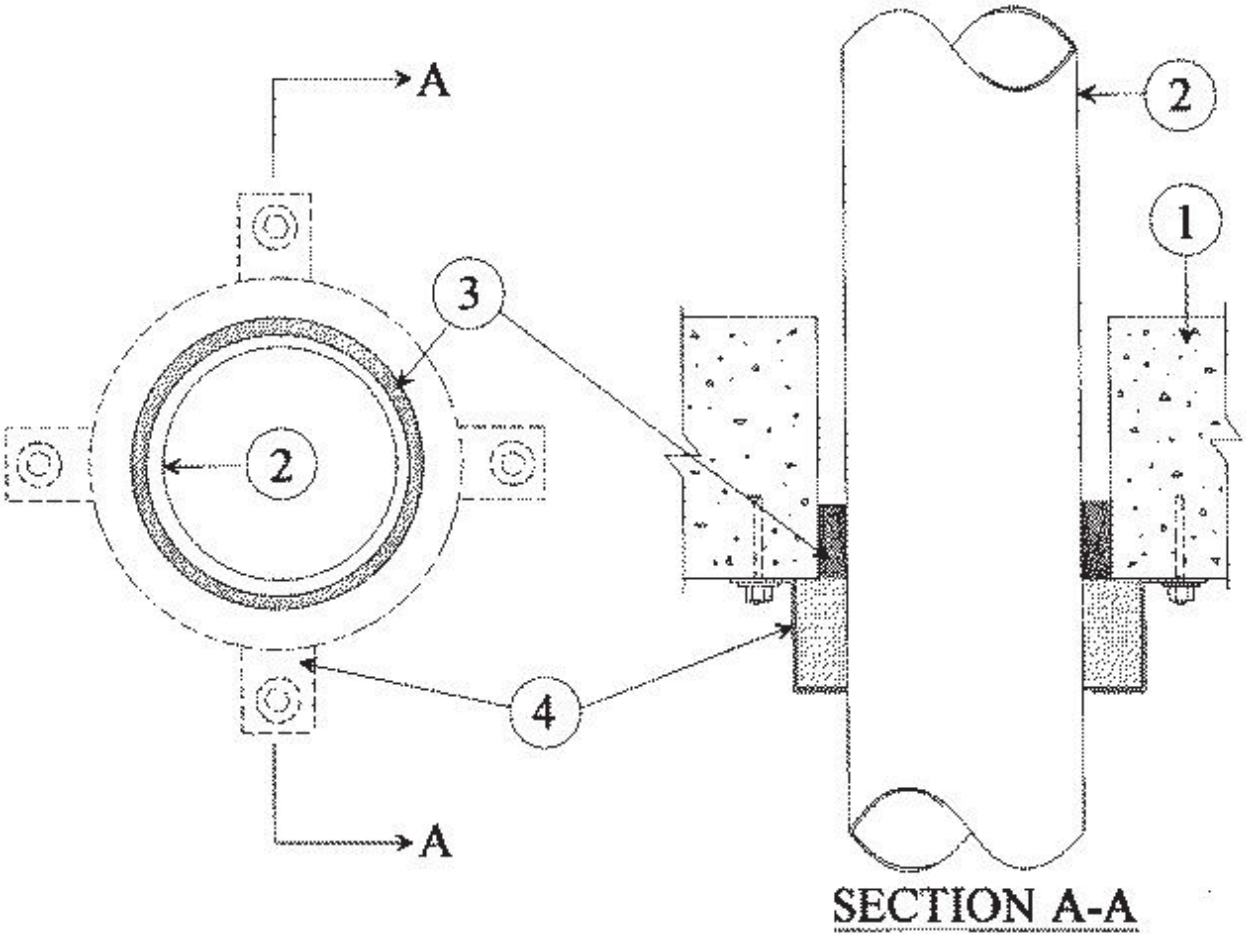
See General Information for Through-penetration Firestop Systems

System No. C-AJ-2217

January 09, 2015

F Rating — 2 Hr

T Rating — 0 Hr



1. **Floor or Wall Assembly —** Min. 4-1/2 in. (114 mm) thick reinforced lightweight or normal weight (100-150 pcf or 1600-2400 kg/m^3) concrete. Wall may also be constructed of any UL Classified **Concrete Blocks.** Max diam of opening is 7 in. (178 mm).

See **Concrete Blocks** (CAZT) category in the Fire Resistance Directory for names of manufacturers.

2. **Through Penetrants —** One nonmetallic pipe to be installed within the firestop system. The annular space shall be min 0 in. to max 3/8 in. (9.5 mm). Pipe to be rigidly supported on both sides of floor or wall assembly. The following types and sizes of nonmetallic pipes may be used:

A. **Polyvinylidene Fluoride (PVDF) Pipe —** Nom 6 in. (152 mm) diam (or smaller) SDR 32.5 PVDF pipe for use in closed (process or supply) or vented (drain, waste or vent) piping systems.

B. **Polypropylene (PP) Pipe —** Nom 4 in. (102 mm) diameter (or smaller) schedule 40 PP for use in closed (process or supply) or vented (drain, waste or vent) piping systems.

3. **Fill, Void or Cavity Material* — Sealant —** Min 1 in. (25 mm) thickness of fill material applied within the annulus, flush with bottom surface of floor or with both surfaces of wall.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — FS-ONE Sealant or FS-ONE MAX Intumescent Sealant

4. **Firestop Device —** Firestop collar shall be installed in accordance with the accompanying installation instructions. Collar to be installed and latched around the pipe and secured to underside of floor on both sides of wall using the anchor hooks provided with the collar. (Minimum two anchor hooks for 1-1/2 and 2 in. diam pipes, three anchor hooks for 3 and 4 in. (102 mm) diam pipes, six anchor hooks for 6 in. (152 mm) diam pipes.). The anchor hooks are to be secured with min 1/4 in. (6 mm) diam by min 1-1/4 in. (32 mm) long steel expansion bolts or min 0.145 in. (3.7 mm) diam by 1-1/4 in. (32 mm) long powder actuated fasteners utilizing a 1-7/16 in. (36.5 mm) diam by 1/16 in. (1.6 mm) thick steel washer. As alternates to the anchors specified above, Hilti 1/4 in. (6 mm) diam by 1-1/4 in. (32 mm) long KWIK-CON II+ concrete screw anchor, Hilti 1/4 in. (6 mm) diam by 1-3/4 in. (44 mm) long KWIK-BOLT 3 steel expansion anchor or Hilti X-DNI 27 P8 S15 powder actuated floor pin with integral nom 9/16 in. (14 mm) diam washer may be used.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — CP 643 50/1.5"N, CP 643 63/2"N, CP 643 90/3"N, CP 643 110/4"N or CP643 160/6"N. Firestop Collar.

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ONLINE CERTIFICATIONS DIRECTORY

System No. C-AJ-5091
XHEZ.C-AJ-5091
Through-penetration Firestop Systems

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XHEZ - Through-penetration Firestop Systems

XHEZ7 - Through-penetration Firestop Systems Certified for Canada

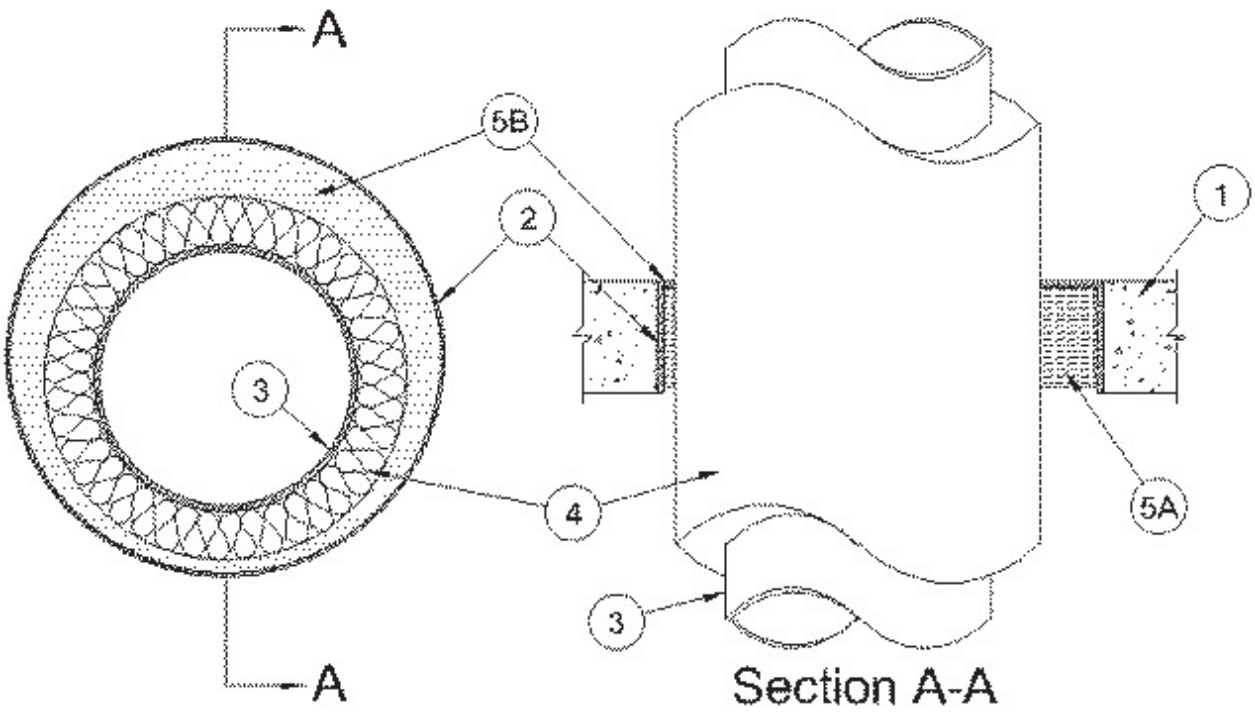
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System No. C-AJ-5091

January 13, 2015

ANSI/UL1479 (ASTM E814)	CAN/ULC S115
F Rating — 2 Hr	F Rating — 2 Hr
T Ratings — 0 and 1 Hr (See Items 2 and 4)	FT Ratings — 0 and 1 Hr (See Items 2 and 4)
L Rating At Ambient — 4 CFM/sq ft	FH Rating — 2 Hr
L Rating At 400 F — Less Than 1 CFM/sq ft	FTH Ratings — 0 and 1 Hr (See Items 2 and 4)
	L Rating At Ambient —4 CFM/sq ft
	L Rating At 400 F —Less Than 1 CFM/sq ft



1. **Floor or Wall Assembly —** Min 4-1/2 in. (114 mm) thick reinforced lightweight or normal weight (100-150 pcf or 1600-2400 kg/m^3) concrete. Wall may also be constructed of any UL Classified **Concrete Blocks*.** Max diam of opening is 29 in. (737 mm).

See **Concrete Blocks** (CAZT) category in the Fire Resistance directory for names of manufacturers.

2. **Metallic Sleeve —** (Optional) — Nom 30 in. (762 mm) diam (or smaller) Schedule 10 (or heavier) steel pipe sleeve cast or grouted into floor or wall assembly, flush with floor or wall surfaces or extending a max of 3 in. (76 mm) above floor or beyond both surfaces of wall. If the steel sleeve extends beyond the top surface of the floor or both surfaces of the wall, the T Rating of the firestop system is 0 hr.

2A. **Sheet Metal Sleeve —** (Optional) - Max 6 in. (152 mm) diam, min 26 ga galv steel provided with a 26 ga galv steel square flange spot welded to the sleeve at approximately mid- height, or flush with bottom of sleeve in floors, and sized to be a min of 2 in. (51 mm) larger than the sleeve diam. The sleeve is to be cast in place flush with bottom surface of floor and may extend a max of 1 in. (25 mm) above the top surface of the floor.

2B. **Sheet Metal Sleeve —** (Optional) - Max 12 in. (305 mm) diam, min 24 ga galv steel provided with a 24 ga galv steel square flange spot welded to the sleeve at approximately mid- height, or flush with bottom of sleeve in floors, and sized to be a min of 2 in. (51 mm) larger than the sleeve diam. The sleeve is to be cast in place flush with bottom surface of floor and may extend a max of 1 in. (25 mm) above the top surface of the floor.

3. **Through Penetrants —** One metallic pipe or tubing to be installed either concentrically or eccentrically within the firestop system. Pipe or tubing to be rigidly supported on both sides of floor or wall assembly. The following types and sizes of metallic pipes or tubing may be used:

A. **Steel Pipe —** Nom 12 in. (305 mm) diam (or smaller) Schedule 10 (or heavier) steel pipe.

B. **Iron Pipe —** Nom 12 in. (305 mm) diam (or smaller) cast or ductile iron pipe.

C. **Copper Pipe —** Nom 6 in. (152 mm) diam (or smaller) Regular (or heavier) copper pipe.

D. **Copper Tubing —** Nom 6 in. (152 mm) diam (or smaller) Type L (or heavier) copper tubing.

4. **Pipe Covering —** Min 1/2 in. (13 mm) to max 2 in. (51 mm) thick hollow cylindrical heavy density (min 3.5 pcf or 56 kg/m^3) glass fiber units jacketed on the outside with an all-service jacket. Longitudinal joints sealed with metal fasteners or factory-applied, self-sealing lap tape. Transverse joints secured with metal fasteners or with butt tape supplied with the product. The annular space between the insulated pipe and the edge of the periphery of the opening shall be min 1/2 in. (13 mm) to max 12 in. (305 mm). **When thickness of pipe covering is less than 2 in. (51 mm), the T Rating for the firestop system is 0 hr.**

See **Pipe Equipment Covering — Materials** — (BRGU) category in the Building Materials Directory for names of manufacturers. Any pipe covering material meeting the above specifications and bearing the UL Classification Marking with a Flame Spread Index of 25 or less and a Smoke Developed Index of 50 or less may be used.

4A. **Pipe Covering —** (Not Shown) — As an alternate to Item 4, max 2 in. (51 mm) thick cylindrical calcium silicate (min 14 pcf or 224 kg/m^3) units sized to the outside diam of the pipe or tube may be used. Pipe insulation secured with stainless steel bands or min 18 AWG stainless steel wire spaced max 12 in. (305 mm) OC. The annular space shall be min 1/2 in. (13 mm) to max 12 in. (305 mm).

5. **Firestop System —** The firestop system shall consist of the following:

A. **Packing Material —** Min 4 in. (102 mm) thickness of min 4 pcf (64 kg/m^3) mineral wool batt insulation firmly packed into opening as a permanent form. Packing material to be recessed from top surface of floor or from both surfaces of wall as required to accommodate the required thickness of fill material.

B. **Fill, Void or Cavity Material* — Sealant —** Min 1/2 in. (13 mm) thickness of fill material applied within the annulus, flush with top surface of floor or with both surfaces of wall.

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ONLINE CERTIFICATIONS DIRECTORY

System No. C-AJ-8041
XHEZ.C-AJ-8041
Through-penetration Firestop Systems

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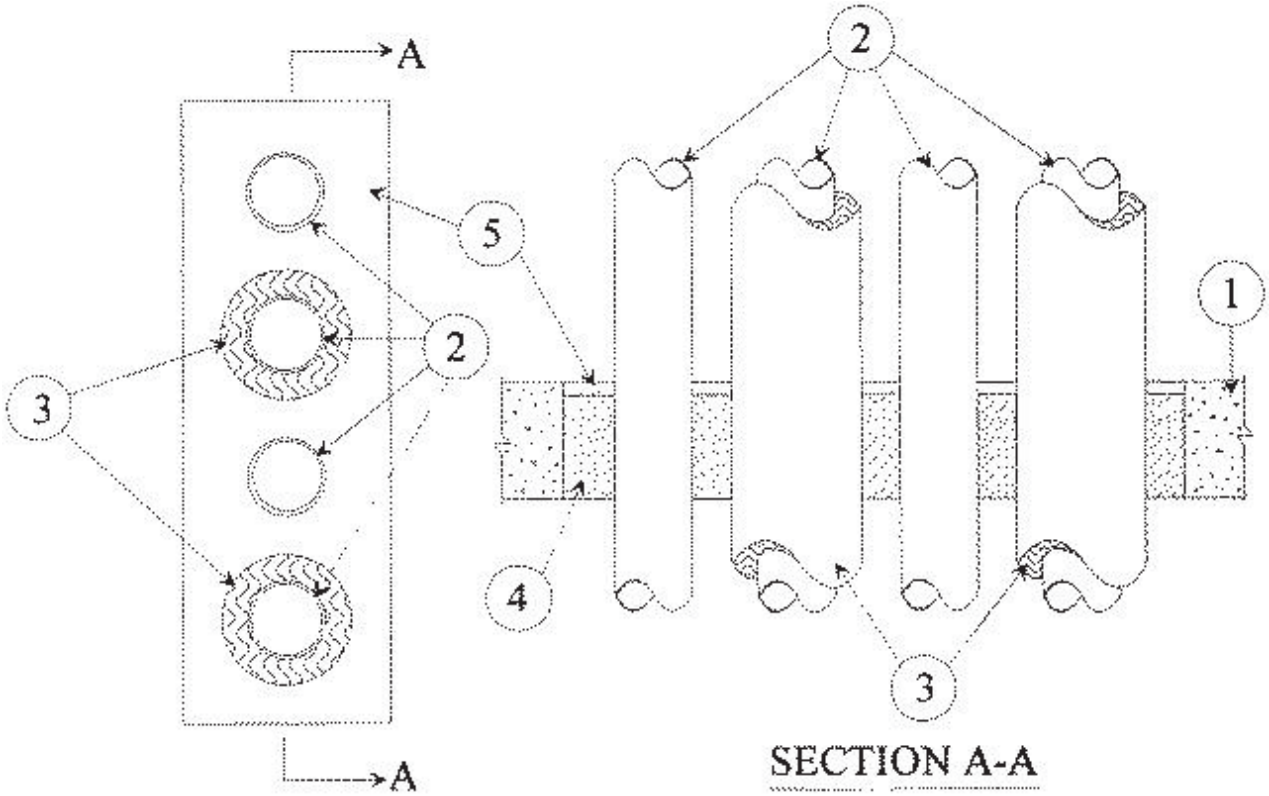
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System No. C-AJ-8041

January 15, 2015

ANSI/UL1479 (ASTM E814)	CAN/ULC S115
F Rating — 3 Hr	F Rating — 3 Hr
T Ratings — 0 and 1 Hr (See Item 3)	FT Ratings — 0 and 1 Hr (See Item 3)
L Rating At Ambient — 10 CFM/sq ft	FH Rating — 3 Hr
L Rating At 400 F — 6 CFM/sq ft	FTH Ratings — 0 and 1 Hr (See Item 3)
	L Rating At Ambient — 10 CFM/sq ft
	L Rating At 400 F — 6 CFM/sq ft



1. **Floor or Wall Assembly —** Min 4-1/2 in. (114 mm) thick reinforced lightweight or normal weight (100-150 pcf or 1600-2400 kg/m^3) concrete floor or min 5 in. (127 mm) thick reinforced lightweight or normal weight (100-150 pcf or 1600-2400 kg/m^3) concrete wall. Wall may also be constructed of any UL Classified **Concrete Blocks***. Max area of opening is 192 sq in. (1239 cm^2) with max dimension of 24 in. 9610 mm).

See **Concrete Blocks** (CAZT) category in the Fire Resistance Directory for names of manufacturers.

2. **Through-Penetrants —** A max of 4 pipes, conduits or tubing to be installed within the opening. The space between pipes, conduits or tubing shall be 1-1/2 in. (38 mm). The space between pipes, conduits or tubing and periphery of opening shall be min 1-5/8 in. (41 mm) to max 2-1/2 in. (64 mm). Pipe, conduit or tubing to be rigidly supported on both sides of floor or wall assembly. The following types and sizes of metallic pipes, conduits or tubing may be used:

A. **Steel Pipe —** Nom 3 in. (76 mm) diam (or smaller) Schedule 10 (or heavier) steel pipe.

B. **Copper Tubing —** Nom 3 in. (76 mm) diam (or smaller) Type L (or heavier) copper tubing.

C. **Copper pipe —** Nom 3 in. (76 mm) diam (or smaller) regular (or heavier) copper pipe.

D. **Conduit —** Nom 3 in. (76 mm) diam (or smaller) electrical metallic tubing or steel conduit.

3. **Pipe Covering* —** (Optional) — Max 1 in. (25 mm) thick hollow cylindrical heavy density (min 3.5 pcf) glass fiber units jacketed on the outside with an all service jacket. Longitudinal joints sealed with metal fasteners or factory-applied self-sealing lap tape. Transverse joints secured with metal fasteners or with butt strip tape supplied with the product. A nom annular space of 1-1/2 in. (38 mm) is required within the firestop system. **The T, FT and FTH Rating is 1 hr when 1 in. thick pipe covering is used. The T, FT and FTH Rating is 0 hr when pipe covering is less than 1 in. or is omitted.**

See **Pipe and Equipment Covering — Materials** (BRGU) category in the Building Materials Directory for names of manufacturers. Any pipe covering material meeting the above specifications and bearing the UL Classification Marking with a Flame Spread Index of 25 or less and a Smoke Developed Index of 50 or less may be used.

4. **Packing Material —** Min 4 in. (102 mm) thickness of min 4.0 pcf (64 kg/m^3) mineral wool batt insulation firmly packed into opening as a permanent form. Packing material to be recessed from top surface of floor or from both surfaces of wall as required to accommodate the required thickness of fill material.

5. **Fill, Void or Cavity Material* — Sealant —** Min 1/2 in. (13 mm) thickness of fill material applied within the annulus, flush with top surface of floor or with both surfaces of wall.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — FS-One Sealant or FS-ONE MAX Intumescent Sealant.

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System No. C-AJ-8056
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Through-penetration Firestop Systems

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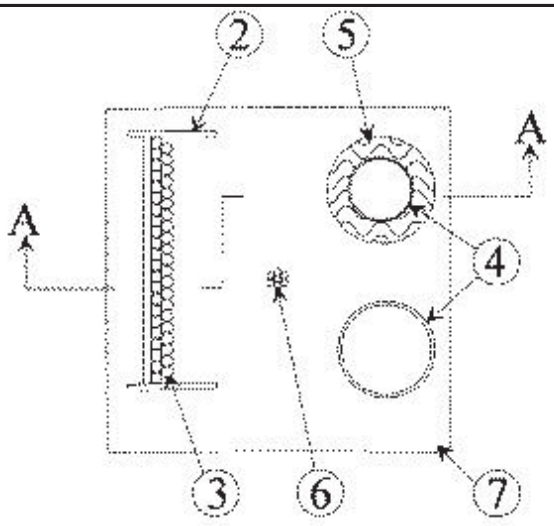
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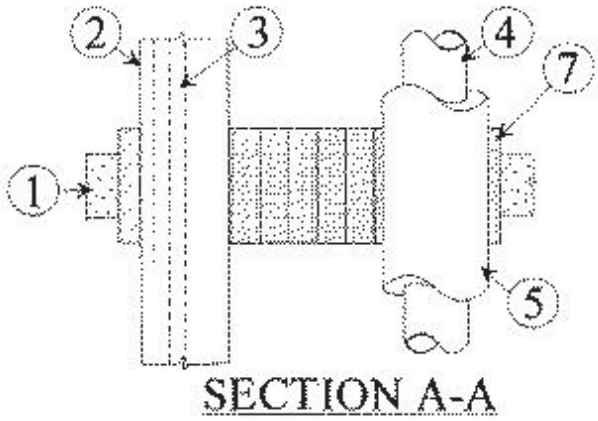
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System No. C-AJ-8056

January 15, 2015

ANSI/UL1479 (ASTM E814)	CAN/ULC S115
F Rating — 3 Hr	F Rating — 3 Hr
T Rating — 0 Hr	FT Rating — 0 Hr
L Rating At Ambient — 5 CFM/sq ft	FH Rating — 3 Hr
L Rating At 400 F — 2 CFM/sq ft	FTH Rating — 0 Hr
	L Rating At Ambient — 5 CFM/sq ft
	L Rating At 400 F — 2 CFM/sq ft





1. **Floor or Wall Assembly —** 4-1/2 in. (114 mm) thick reinforced lightweight or normal weight (100-150 pcf or 1600-2400 kg/m^3) concrete. Wall may also be constructed of any UL Classified **Concrete Blocks***. Max area of opening is

1296 in. sq (8361 cm^2) with max dimension of 36 in. (914 mm).

See **Concrete Blocks** (CAZT) category in the Fire Resistance Directory for names of manufacturers.

2. **Cable Tray* —** Max 18 in. (457 mm) wide by max 6 in. (152 mm) deep open-ladder or solid-back cable tray with channel-shaped side rails formed of 0.060 in. (1.52 mm) thick aluminum or steel and with 1-1/2 in. (38 mm) wide by 1 in. (25 mm) channel shape rungs spaced 9 in. (229 mm) OC or a 0.029 in. (0.74 mm) thick steel solid back, respectively. One cable tray to be installed in the opening. The max annular space between the cable tray and adjacent penetrants is 9 in. (229 mm) and between the cable tray and periphery of the opening shall be min 1-1/2 in. (38 mm) to max 4-1/2 in. (114 mm). Cable tray to be rigidly supported on both sides of floor or wall assembly.

3. **Cables —** Aggregate cross-sectional area of cables in cable tray to be max 30 percent of the cross-sectional area of the cable tray based on a max 3 in. (76 mm) cable loading depth within the cable tray. Any combination of the following types and sizes of copper conductor or fiber optic cables may be used:

A. 7/C No. 12 AWG with polyvinyl chloride (PVC) insulation and PVC jacket.

B. 300 pair - No. 24 AWG cable with PVC insulation and jacket.

C. 1/C, 350 kcmil with cross-linked polyethylene (XLPE) insulation and jacket.

D. 1/C, 500 kcmil with thermo plastic insulation and polyvinyl chloride (PVC) jacket.

E. Twenty four fiber optic cable with PVC sub unit and jacket.

4. **Through-Penetrants —** One or more pipe, conduit or tube to be installed within the opening. The total number of through-penetrants is dependent on the size of the opening and types and sizes of the penetrants. Any combination of the penetrants described below may be used provided that the following parameters relative to the annular spaces and the spacings between the pipes are maintained. The space between pipes, conduits or tubing and between the periphery of the opening and the pipes or conduits shall be min 1 in. (25 mm) to max 4-1/2 in. (114 mm). Pipe, conduit or tube to be rigidly supported on both sides of floor or wall assembly. The following types and sizes of metallic pipes, conduits or tubing may be used:

A. Nom 6 in. (152 mm) diam (or smaller) rigid galv steel conduit.

B. Nom 4 in. (102 mm) diam (or smaller) steel electrical metallic tubing.

C. Nom 4 in. (102 mm) diam (or smaller) Regular (or heavier) copper pipe.

D. Nom 4 in. (102 mm) diam (or smaller) Type L (or heavier) copper tube.

E. Nom 6 in. (152 mm) diam (or smaller) Schedule 10 (or heavier) steel pipe.

F. Nom 6 in. (152 mm) diam (or smaller) cast or ductile iron pipe.

5. **Pipe Covering —** Nom 1-1/2 in. (38 mm) thick hollow cylindrical heavy density (min 3.5 pcf) glass fiber units jacketed on the outside with an all service jacket. Longitudinal joints sealed with metal fasteners or factory applied self-sealing lap tape. Transverse joints secured with metal fasteners or with butt tape supplied with the product.

See **Pipe and Equipment Covering and Materials** (BRGU) category in the Building Materials Directory for names of manufacturers. Any pipe covering material meeting the above specifications and bearing the UL Classification Marking with a Flame Spread Index of 25 or less and a Smoke Developed Index of 50 may be used.

6. **Cables —** Max 2 in. (51 mm) diam tight bundle of cables centered in opening and rigidly supported on both surfaces of floor and wall. Any combination of the following types and sizes of cables may be used:

A. 7/C No. 12 AWG with polyvinyl chloride (PVC) insulation and PVC jacket.

B. 25 pair - No. 24 AWG cable with PVC insulation and jacket.

C. 2/C No. 10 AWG with PVC insulation and jacket.

D. 3/C No. 8 AWG aluminum clad cable with cross-linked polyethylene (XLPE) insulation and PVC jacket.

E. Type RC - 62 A/U coaxial cable with air core and PVC jacket.

F. 24 fiber optic cable with PVC sub unit and outer jacket.

7. **Firestop System —** The firestop system shall consist of the following:

A. **Fill, Void or Cavity Material* —** Fire blocks installed with long dimension passed through the opening and centered within the thickness of the floor or wall. Blocks to be firmly packed and completely fill the entire area and thickness of opening. Either one or a combination of the block types specified below may be used.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — FS 657 -Fire Block or CFS-BL Firestop Block

B. **Fill, Void or Cavity Material* —** (Not Shown) Fill material to be forced into interstices of cables and between cables and cable trays to max extent possible on both surfaces of the penetration.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — FS-One Sealant, FS-ONE MAX Intumescent Sealant, or CP618 Firestop Putty Stick (L Rating applies only when FS-One Sealant

is used.)

C. **Wire Mesh (Not Shown) —** When the annular space exceeds 4-1/2 in. (114 mm) to the periphery, a nom 2 in. sq (51 mm sq.) wire fencing shall be used to keep the fire blocks in place. The wire fencing is fabricated from min No. 16 SWG (0.060 in.) (1.52 mm) galv steel wire. The wire is cut to fit the contour of the penetrating item with a min 3 in. (76 mm) lap beyond the periphery of the opening. Wire fencing secured to top surface of floor and both surfaces of wall assembly by means of 1/4 in. (6 mm) diam by 1 in. (25 mm) long concrete anchors and 1/4 in. (6 mm) by 1-1/2 in. (38 mm) diam fender washers spaced max 8 in. (203 mm) OC.

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ONLINE CERTIFICATIONS DIRECTORY

System No. C-BJ-4025
XHEZ.C-BJ-4025
Through-penetration Firestop Systems

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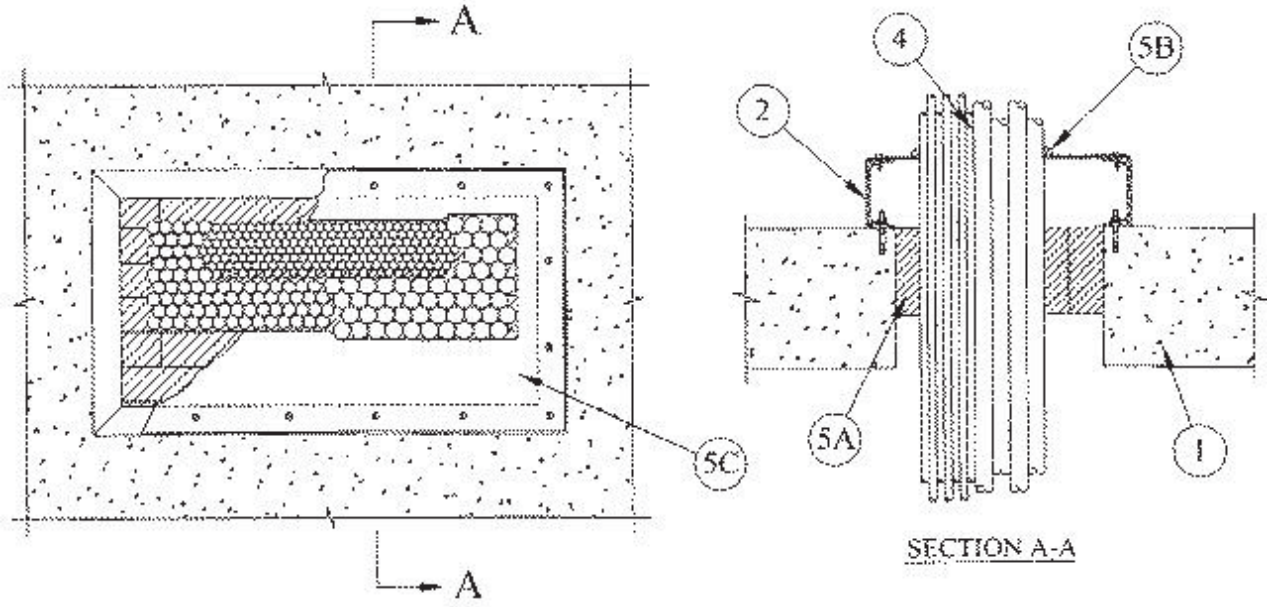
See General Information for Through-penetration Firestop Systems

See General Information for Through-penetration Firestop Systems Certified for Canada

System No. C-BJ-4025

January 16, 2015

ANSI/UL1479 (ASTM E814)	CAN/ULC S115
F Rating — 2 Hr	F Rating — 2 Hr
T Ratings - 0, 1 and 1-1/2 Hr (See Items 4 and 5C)	FT Ratings - 0, 1 and 1-1/2 Hr (See Items 4 and 5C)
	FH Rating — 2 Hr
	FTH Ratings - 0, 1 and 1-1/2 Hr (See Items 4 and 5C)



1. **Floor or Wall Assembly —** Min 8 in. (203 mm) thick reinforced lightweight or normal weight (100-150 pcf) concrete. Max area of opening is 288 sq in. (1858 cm^2) with max dimension of 24 in. (610 mm).

2. **Sheathing —** Nom 1-1/2 in. (38 mm) by 4 in. (102 mm) by 3/16 in. (4.8 mm) thick steel channel shaped members secured to the concrete (Item 1) by means of 1/4 in. (6 mm) diam by 1-1/4 in. (32 mm) long concrete screw fasteners spaced 6 in. (152 mm) to 8 in. (203 mm) OC. The sheathing shall completely enclose the perimeter of the opening on top surface of floor assembly and one surface of wall assembly for asymmetrical systems and both surfaces of wall assembly for symmetrical systems.

3. **Cable Rack —** (Not Shown)—Max 20 in. (508 mm) wide cable rack, fabricated from min 1/4 in. (6 mm) thick by 1-1/2 in. (38 mm) wide steel bar side rails and 3/16 in. (4.8 mm) thick by 1 in. (25 mm) wide C-shaped rungs spaced 9 in. (229 mm) OC. Cable rack shall be welded or bolted to top surface of sheathing (Item 2).

4. **Cables —** Aggregate cross-sectional area of cables in opening to be max 34 percent of the cross-sectional area of the opening. The annular space between cables and the periphery of the opening to be min 1 in. (25 mm). Cables to be rigidly supported on both sides of floor or wall assembly. Any combination of the following types and sizes of cables may be used:

A. Max 300 pair No. 24 AWG telephone cable with polyvinyl chloride (PVC) insulation and jacket.

B. Max 750 kcmil power cable with cross-linked polyethylene (XLPE) insulation and polyvinyl chloride (PVC) jacket.

C. Multiple fiber optic communication cable with polyvinyl chloride (PVC) jacket, having a max OD of 1/2 in. (13 mm).

The T Rating of the firestop system is dependent upon the type of cable used within the firestop system as shown in the following table:

Cable Identification	T, FT and FTH Ratings, Hr
A	1-1/2
B and C	1

5. **Firestop System —** The firestop system may be installed as an asymmetrical system in a floor and symmetrical or asymmetrical system in a wall assembly. The firestop system shall consist of the following items:

A. **Fill, Void or Cavity Materials*—Fire Blocks —** Fire blocks installed with 5 in. (127 mm) dimension projecting through the opening, flush with the top surface of concrete or either wall surface. Blocks to be firmly packed and completely fill the entire length and width of the opening. Either one or a combination of the block types specified below may be used.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — FS 657 Fire Block or CFS-BL Firestop Block

B. **Fill, Void or Cavity Materials*—Putty —** When cover plate is used, formed into pads 1/4 in. (6 mm) thick, installed around periphery of cable bundle, extending min 2 in. (51 mm) onto penetrant and overlapping cover plate by min 1/2 in. (13 mm).

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — CP 618 Firestop Putty Stick

B1. **Fill, Void or Cavity Materials*—Sealant (Optional) (Not Shown) —** When cover plate is used, min 1/2 in. (13 mm) thickness of fill material to be applied at cables/cover plate interface. Additional 3/8 in. (9.53 mm) bead of fill material applied at fill cover plate interface, overlapping cover plate.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — FS-ONE Sealant or FS-ONE MAX Intumescent Sealant.

C. **Steel Cover Plate (Optional) —** Min 0.020 in. (0.51 mm) thick (No. 22 MSG) steel plate shall be cut to fit contour of the cable bundle. Steel cover plate secured to the sheathing with 1/4-20 bolts or screws spaced max 12 in. (305 mm) OC. Annular space between the cables and the cover plate shall be min 0 in. (point contact) to max 1 in. (25 mm). Annular space between cables and sheathing shall be min 0 in. (point contact) to max 1 in. (25 mm). In order to achieve a T, FT and FTH Rating greater than 0 Hr, the annular spaces shall be treated as described in Items 5B and 5B1. When the cover plate is not used or annular spaces are not treated, the T, FT and FTH Ratings are 0 Hr.

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ONLINE CERTIFICATIONS DIRECTORY

System No. C-BJ-4026
XHEZ.C-BJ-4026
Through-penetration Firestop Systems

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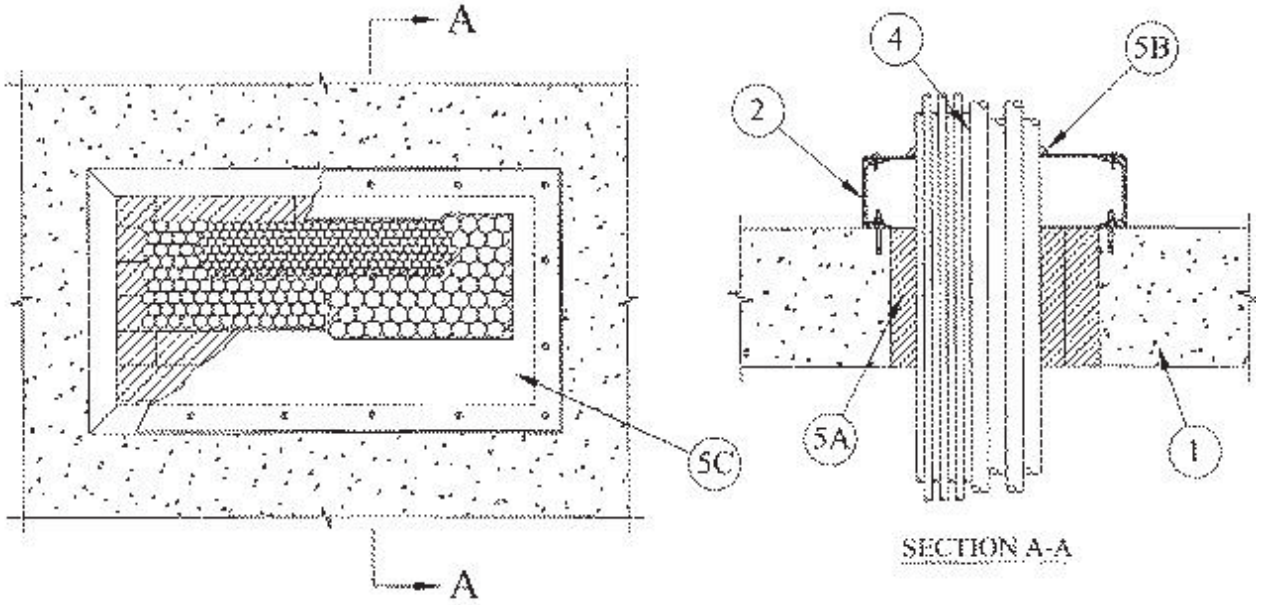
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See General Information for Through-penetration Firestop Systems Certified for Canada

System No. C-BJ-4026

January 16, 2015

ANSI/UL1479 (ASTM E814)	CAN/ULC S115
F Rating — 2 Hr	F Rating — 2 Hr
T Ratings - 0 and 1-1/2 Hr (See Item 5C)	FT Ratings - 0 and 1-1/2 Hr (See Item 5C)
	FH Rating — 2 Hr
	FTH Ratings - 0 and 1-1/2 Hr (See Item 5C)



1. **Floor or Wall Assembly —** Min 8 in. (203 mm) thick reinforced lightweight or normal weight (100-150 pcf or 1600-2400 kg/m^3) concrete. Max area of opening is 288 sq in. (1858 cm^2) with max dimension of 24 in. (610 mm).

2. **Sheathing —** Nom 1-1/2 in. (38 mm) by 4 in. (102 mm) by 3/16 in. (4.8 mm) thick steel channel channel-shaped members secured to the concrete (Item 1) by means of 1/4 in. (6 mm) diam by 1-1/4 in. (32 mm) long concrete screw fasteners spaced 6 in. (152 mm) to 8 in. (203 mm) OC. The sheathing shall completely enclose the perimeter of the opening on the top surface of the floor assembly or on one surface of wall assembly for asymmetrical systems and on both surfaces of wall assembly for symmetrical systems.

3. **Cable Rack —** Max 20 in. (508 mm) wide cable rack, fabricated from min 1/4 in. (6 mm) thick by 1-1/2 in. (38 mm) wide steel bar side rails and 3/16 in. (4.8 mm) thick by 1 in. (25 mm) wide C-shaped steel rungs spaced 9 in. (229 mm) OC. Cable rack shall be welded or bolted to top surface of sheathing (Item 2).

4. **Cables —** Aggregate cross-sectional area of cables in opening to be max 34 percent of the cross-sectional area of the opening. The annular space between cables and the periphery of the opening to be min 1 in. (25 mm). Cables to be rigidly supported on both sides of floor or wall assembly. Any combination of the following types and sizes of cables may be used:

A. Max 300 pair No. 24 AWG telephone cable with polyvinyl chloride (PVC) insulation and jacket.

B. Max 750 kcmil power cable with cross-linked polyethylene (XLPE) insulation and polyvinyl chloride (PVC) jacket.

C. Multiple fiber optic communication cable with polyvinyl chloride (PVC) jacket, having a max OD of 1/2 in. (13 mm).

5. **Firestop System —** The firestop system may be installed as an asymmetrical system in a floor and symmetrical or asymmetrical system in a wall assembly. The firestop system shall consist of the following items:

A. **Fill, Void or Cavity Materials*—Fire Blocks —** Fire blocks installed with long dimension projecting through the opening flush with the top surface of concrete floor or either wall surface. Blocks to be firmly packed and completely fill the entire length and width of the opening. Either one or a combination of the block types specified below may be used.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — FS 657 Fire Block or CFS-BL Firestop Block

B. **Fill, Void or Cavity Materials*—Putty —** When cover plate is used, formed into pads 1/4 in. (6 mm) thick, installed around periphery of cable bundle, extending min 2 in. (51 mm) onto penetrant and overlapping cover plate by min 1/2 in. (13 mm).

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — CP 618 Firestop Putty Stick

B1. **Fill, Void or Cavity Materials*—Sealant —** When cover plate is used, min 1/2 in. (13 mm) thickness of fill material to be applied at cables/cover plate interface. Additional 3/8 in. (9.53 mm) bead of fill material applied at fill cover plate interface, overlapping cover plate.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — FS-ONE Sealant or FS-ONE MAX Intumescent Sealant.

C. **Steel Cover Plate (Optional) —** Min 0.020 in. (0.51 mm) thick (No. 22 MSG) steel plate shall be cut to fit contour of the cable bundle. Steel cover plate secured to the sheathing with 1/4-20 bolts or screws spaced max 12 in. (305 mm) OC. As an alternate fastener, Southco® Medium Bail Style Quarter-turn steel stud/receptacle fasteners may be used. Annular space between the cables and the cover plate shall be min 0 in. (point contact) to max 1 in. (25 mm). Annular space between cables and sheathing shall be min 0 in. (point contact) to max 1 in. (25 mm). In order to achieve a T, FT And FTH Rating of 1-1/2 Hr, the annular spaces shall be treated as described in Items 5B and 5B1. When the cover plate is not used or annular spaces are not treated, the T, FT and FTH Ratings are 0 Hr.

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ONLINE CERTIFICATIONS DIRECTORY

System No. F-A-1014
XHEZ.F-A-1014
Through-penetration Firestop Systems

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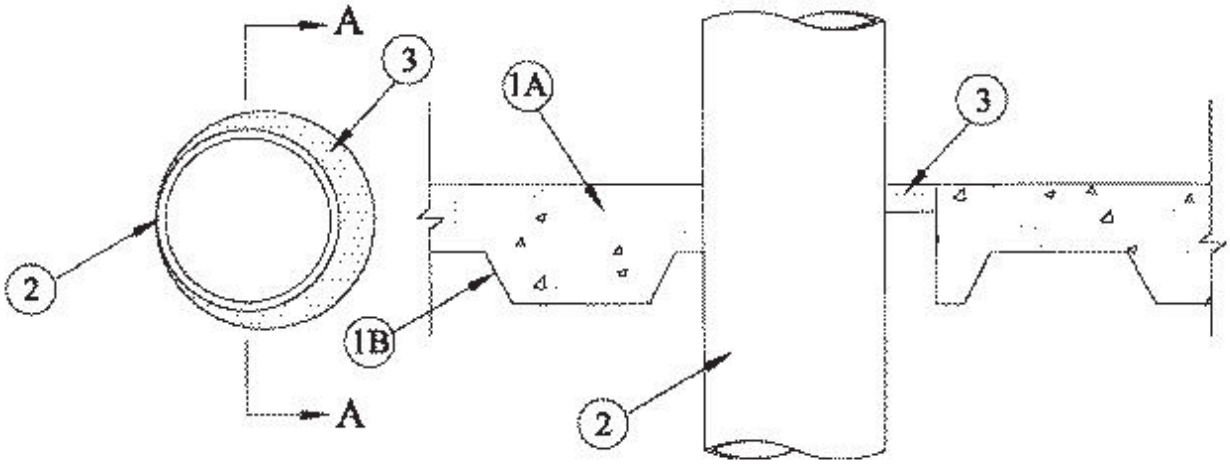
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System No. F-A-1014

January 16, 2015

ANSI/UL1479 (ASTM E814)	CAN/ULC S115
F Rating — 2 Hr	F Rating — 2 Hr
T Rating — 0 Hr	FT Rating — 0 Hr
	FH Rating — 2 Hr
	FTH Rating — 0 Hr



SECTION A-A

1. **Floor Assembly —** The fire rated unprotected concrete and steel floor assembly shall be constructed of the materials and in the manner specified in the individual D900 Series designs in the UL Fire Resistance Directory and as summarized below:

A. **Concrete —** Min 2-1/2 in. (64 mm) thick reinforced lightweight or normal weight (100-150 pcf or 1600-2400 kg/m^3) concrete.

B. **Steel Floor and Form Units* —** Composite or non-composite max 3 in. (76 mm) deep galv steel fluted units as specified in the individual Floor-Ceiling Design. Max diam of opening is 14-5/8 in. (371 mm).

2. **Through Penetrants —** One metallic tubing, pipe or conduit to be installed within the firestop system. Pipe, tubing or conduit to be rigidly supported on both sides of floor-ceiling assembly. The annular space between pipe, tubing or conduit and periphery of opening shall be min of 0 in. (point contact) to max 1-7/8 in. (48 mm). The following types and sizes of metallic pipes, tubing or conduit may be used:

A. **Steel Pipe —** Nom 12 in. (305 mm) diam (or smaller) Schedule 10 (or heavier) steel pipe.

B. **Conduit —** Nom 4 in. (102 mm) diam (or smaller) steel electrical metallic tubing or nom 6 in. (152 mm) diam (or smaller) steel conduit.

C. **Copper Tube —** Nom 6 in. (152 mm) diam (or smaller) Type L (or heavier) copper tube.

D. **Copper Pipe —** Nom 6 in. (152 mm) diam (or smaller) Regular (or heavier) copper pipe.

3. **Fill, Void or Cavity Materials*-Sealant —** Min 1 in. (25 mm) thickness of sealant applied within annular space, flush with top surface of floor. At the point contact location, between pipe and concrete, a min 1/2 in. (13 mm) diam bead of fill material shall be applied at the concrete/pipe interface on the top surface of floor.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — FS-ONE Sealant or FS-ONE MAX Intumescent Sealant.

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ONLINE CERTIFICATIONS DIRECTORY

System No. F-A-1028
XHEZ.F-A-1028
Through-penetration Firestop Systems

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- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.
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XHEZ7 - Through-penetration Firestop Systems Certified for Canada

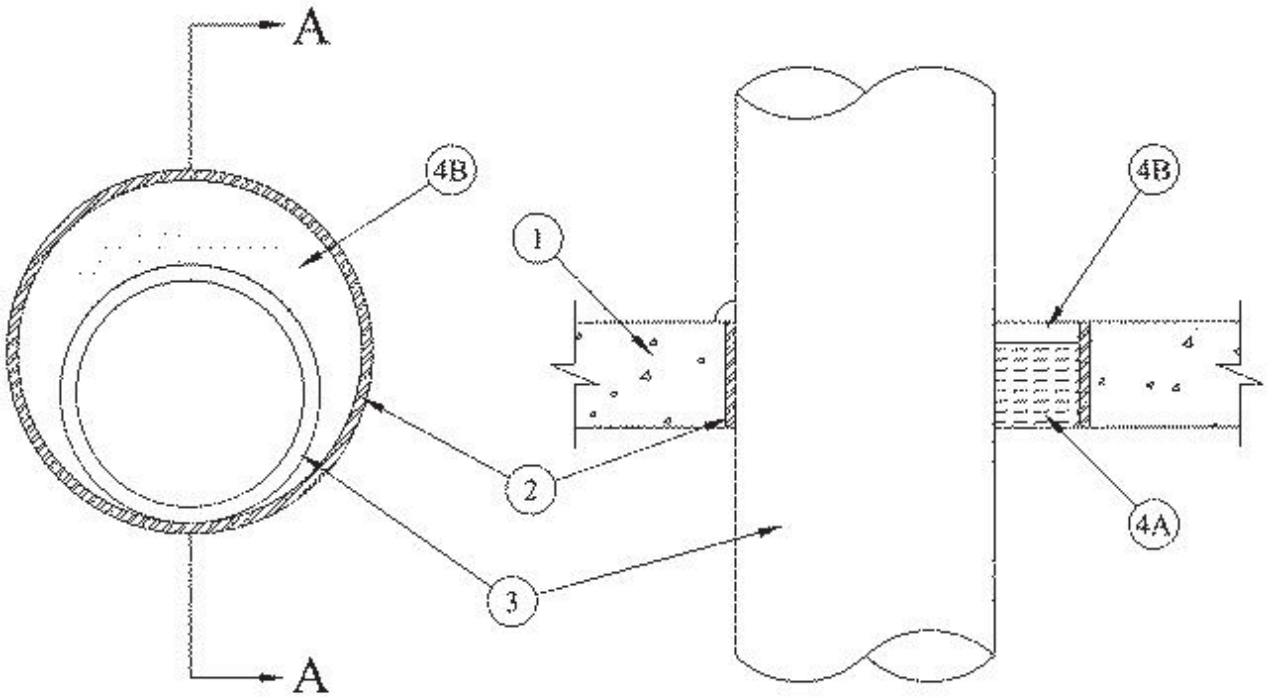
See General Information for Through-penetration Firestop Systems

See General Information for Through-penetration Firestop Systems Certified for Canada

System No. F-A-1028

January 15, 2015

ANSI/UL1479 (ASTM E814)	CAN/ULC S115
F Rating — 2 Hr	F Rating — 2 Hr
T Rating — 0 Hr	FT Rating — 0 Hr
	FH Rating — 2 Hr
	FTH Rating — 0 Hr



SECTION A-A

1. **Floor Assembly —** Min 2-1/2 in. (64 mm) thick reinforced lightweight or normal weight (100-150 pcf or 1600-2400 kg/m^3) concrete. Max diameter of opening is 31-7/8 in. (810 mm).

1A. **Floor Assembly —** (Optional) - (Not Shown) -The fire rated unprotected concrete and steel floor assembly shall be constructed of the materials and in the manner specified in the individual D900 Series designs in the UL Fire Resistance Directory and as summarized below.

A. **Concrete —** Min 2-1/2 in. (64 mm) thick reinforced lightweight or normal weight (100-150 pcf or 1600-2400 kg/m^3) concrete.

B. **Steel Floor and Form Units* —** Composite or non-composite max 3 in. (76 mm) deep galv steel fluted units as specified in the individual Floor-Ceiling Design. Max diam of opening is 31-7/8 in. (810 mm).

2. **Steel Sleeve —** (Optional) - Nom 32 in. (813 mm) diam (or smaller) Schedule 40 steel pipe cast or grouted into floor assembly, flush with floor surfaces.

2A. **Sheet Metal Sleeve —** (Optional) - Max 6 in. (152 mm) diam, min 26 ga galv steel provided with a 26 ga galv steel square flange spot welded to the sleeve at approx mid-height, or flush with bottom of sleeve in floors, and sized to be a min of 2 in. (51 mm) larger than the sleeve diam. The sleeve is to be cast in place and may extend a max of 4 in. (102 mm) below the bottom of the deck and a max of 1 in. (25 mm) above the top surface of the concrete floor.

2B. **Sheet Metal Sleeve —** (Optional) - Max 12 in. (305 mm) diam, min 24 ga galv steel provided with a 24 ga galv steel square flange spot welded to the sleeve at approx mid-height, or flush with bottom of sleeve in floors, and sized to be a min of 2 in. (51 mm) larger than the sleeve diam. The sleeve is to be cast in place may extend a max of 4 in. below the bottom of the deck and a max of 1 in. (25 mm) above the top surface of the concrete floor.

3. **Through Penetrants —** One metallic pipe, conduit or tubing to be installed concentrically within the firestop device. Pipe, conduit or tubing to be rigidly supported on both sides of floor assembly. The annular space between pipe conduit or tubing and the periphery of the opening shall be min 0 in. (point contact) to max 1-7/8 in. (48 mm).

The following types of pipe, conduit or tubing may be used:

Steel Pipe — Nom 30 in. (762 mm) diam (or smaller) Schedule 10 (or heavier) steel pipe.

Iron Pipe — Nom 30 in. (762 mm) diam (or smaller) cast or ductile iron pipe.

Conduit — Nom 6 in. (152 mm) diam (or smaller) rigid steel conduit.

Conduit — Nom 4 in. (102 mm) diam (or smaller) steel electrical metallic conduit.

Copper Tubing — Nom 6 in. (152 mm) diam (or smaller) Type L (or heavier) copper tubing.

Copper Pipe — Nom 6 in. (152 mm) diam (or smaller) Regular (or heavier) copper pipe.

4. **Firestop System —** The firestop system shall consist of the following:

A. **Packing Material —** Min 2. (51 mm) in thickness of min 4 pcf (64 kg/m^3) mineral wool batt insulation tightly packed into the opening as a permanent form. Packing material to be recessed from top surface of floor as required to accommodate the required thickness of fill material.

B. **Fill, Void or Cavity Materials* - Sealant —** Min 1/2 in. (13 mm) thickness of fill material

applied within the annulus, flush with top surface of floor. At point contact, a min 1/2 in. (13 mm) diam bead of fill material shall be applied at the concrete/sleeve/pipe interface on top surface of floor.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — FS-ONE Sealant or FS-ONE MAX Intumescent Sealant

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Last Updated on 2015-01-15

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ONLINE CERTIFICATIONS DIRECTORY

System No. F-A-2025
XHEZ.F-A-2025
Through-penetration Firestop Systems

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XHEZ - Through-penetration Firestop Systems

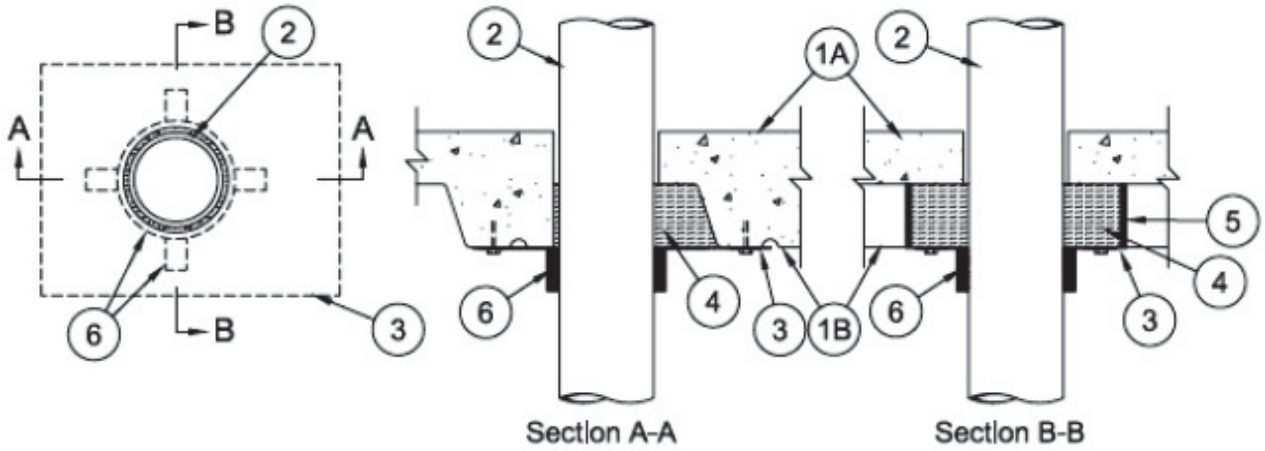
See General Information for Through-penetration Firestop Systems

System No. F-A-2025

January 15, 2015

F Rating — 2 Hr

T Rating — 2 Hr



1. **Floor Assembly —** The fire-rated unprotected concrete and steel floor assembly shall be constructed of the materials and in the manner specified in the individual D900 Series designs in the UL Fire Resistance Directory and as summarized below:

A. **Normal Weight Concrete —** Min 2-1/2 in. (64 mm) thickness of lightweight or normal weight (100-150 pcf or 1600-2400 kg/m^3) concrete topping as measured over the crests of the steel floor units.

B. **Steel Floor and Form Units* —** Composite or noncomposite 3 in. (76 mm) deep fluted galv units as specified in the individual Floor-Ceiling design. Max diam of opening core-drilled through floor assembly is 8 in. (203 mm).

2. **Through Penetrants —** One nonmetallic pipe to be installed either concentrically or eccentrically within the firestop system. The annular space between pipe and periphery of opening shall be min 0 in. (0 mm, point contact) to max 1-1/2 in. (38 mm). Pipe to be rigidly supported on both sides of floor assembly. The following types and sizes of nonmetallic pipes may be used:

A. **Polyvinyl Chloride (PVC) Pipe —** Nom 6 in. (152 mm) diam (or smaller) Schedule 40 solid-core or cellular core PVC pipe for use in closed (process or supply) or vented (drain, waste or

vent) piping system.

B. **Chlorinated Polyvinyl Chloride (CPVC) Pipe —** Nom 6 in. (152 mm) diam (or smaller) SDR13.5 CPVC pipe for use in closed (process or supply) piping systems.

C. **Acrylonitrile Butadiene Styrene (ABS) Pipe —** Nom 6 in. (152 mm) diam (or smaller) Schedule 40 solid-core or cellular core ABS pipe for use in closed (process or supply) or vented (drain, waste or vent) piping systems.

D. **Flame Retardant Polypropylene (FRPP) Pipe —** Nom 6 in. (152 mm) diam (or smaller) Schedule 40 FRPP pipe for use in closed (process or supply) or vented drain, waste or vent) piping systems.

3. **Metal Plate Enclosure —** Min 18 ga steel. Width of plate to be min 12 in. (305 mm). Length of plate (transverse to steel floor unit direction) to extend to steel floor unit valley beyond each side of core-drilled hole with a min lap of 1-1/2 in. (38 mm) on the floor unit valley at each end. Both ends of plate perpendicular to floor unit valleys to be cut to permit the ends to be bent upwards 90 F deg to follow the contour of the floor unit, enclosing the packing material (Item 4) within the areas of the flutes. The contoured plate ends shall be such that the gap between the floor unit and the plate ends is no greater than 1/4 in. (6 mm). As an alternate to bending up ends of plate, min 1/4 in. (6 mm) thickness of fill material (Item 5) shall be applied to completely cover the surface of the mineral wool packing material within the flutes of the steel floor units, between the two ends of the metal enclosure plate and the steel floor units. Circular cutout in plate to tightly follow circumference of nonmetallic pipe with side edges of plate at least 3 in. (76 mm) from circular cutout on all sides. Slit made in plate to permit installation around the nonmetallic pipe to be located at end of plate beneath floor unit valley nearest to the circular cutout. Plate secured to valleys of floor unit using min 1/4 in. (6 mm) diam by 1-3/4 in. (45 mm) long steel expansion bolts, or equivalent, in conjunction with min 3/4 in. (19 mm) diam steel washers or min 0.145 in. (4 mm) diam by 1-1/4 in. (32 mm) long powder actuated fasteners utilizing a 1-7/16 in. (36 mm) diam by 1/16 in. (2 mm) thick steel washer. As alternates to the anchors specified above, Hilti 1/4 in. (6 mm) diam by 1-1/4 in. (32 mm) long KWIK-CON II+ concrete screw anchor, Hilti 1/4 in. (6 mm) diam by 1-3/4 in. (44 mm) long KWIK-BOLT 3 steel expansion anchor or Hilti X-DNI 27 P8 S15 powder actuated floor pin with integral nom 9/16 in. (15 mm) diam washer may be used . Fasteners to be located approx 1 in. (25 mm) from edges of plate at each corner, at each plate/valley intersection and at both sides of slit made to permit installation around nonmetallic pipe. Spacing of fasteners no to exceed 10 in. (254 mm) OC.

4. **Packing Material —** Mineral wool batt insulation having min density of 4 pcf (64 kg/m^3), firmly packed into flutes of steel floor units above metal plate enclosure (Item 3) to completely fill cavities. When ends of metal plate enclosure perpendicular to floor unit valleys are not bent up to enclose packing material within flutes (see Item 3), packing material to be recessed from ends of plate to accommodate the required thickness of the fill material.

5. **Fill, Void or Cavity Material* — Sealant —** Nom 1/2 in. (13 mm) bead of fill material applied around the perimeter of the metal plate enclosure at the interface of the enclosure and steel deck. When ends of metal plate enclosure (Item 3) are not bent up to enclose packing material within flutes, min 1/4 in. (6 mm) thickness of fill material shall be applied to completely cover the surface of the mineral wool packing material within the flutes of the steel floor units, between the two ends of the metal enclosure plate and the steel floor units.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — FS-One Sealant or FS-ONE MAX Intumescent Sealant

6. **Firestop Device* — Firestop Collar —** Firestop collar shall be installed in accordance with the accompanying installation instructions. Collar to be installed and latched around the pipe and secured to the valley of the steel deck and to the metal plate enclosure using the anchor hooks provided with the collar. Min of two anchor hooks required for 1-1/2 and 2 in. (38 and 51 mm) diam pipes, min of three anchor hooks required for 3 and 4 in. (76 and 102 mm) diam pipes, and min of four anchor hooks required for 6 in. (152 mm) diam pipes. Where the anchor hooks are beneath the valley of the steel floor unit, the anchor tabs are to be secured with 1/4 in. (6 mm) diam by min 1-1/2 in. (38 mm) long steel expansion bolts, or equivalent, in conjunction with steel nuts and min 3/4 in. (19 mm) diam steel washers with one anchor bolt in each anchor hook. Where the anchor hooks are beneath the crest of the steel deck, the anchor hooks are to be secured to the metal enclosure with No. 10 by min 1/2 in. (13 mm) long self-drilling, self-tapping steel screws and min 3/4 in. (19 mm) diam steel washers.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — CP 643 50/1.5"N, CP 643 63/2"N, CP643 90/3"N, CP 643 110/4"N or CP 643 160/6"N Firestop Collar

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ONLINE CERTIFICATIONS DIRECTORY

System No. F-A-3012
XHEZ.F-A-3012
Through-penetration Firestop Systems

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XHEZ - Through-penetration Firestop Systems

XHEZ7 - Through-penetration Firestop Systems Certified for Canada

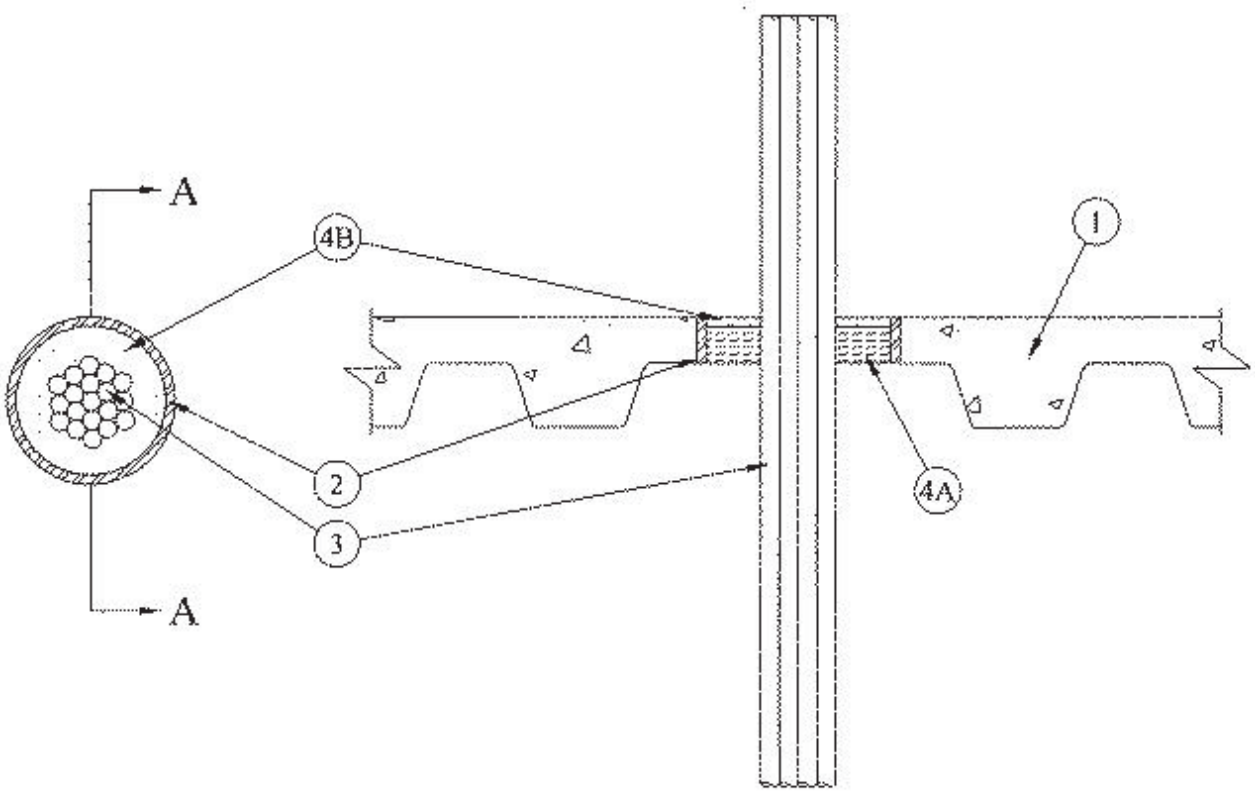
See General Information for Through-penetration Firestop Systems

See General Information for Through-penetration Firestop Systems Certified for Canada

System No. F-A-3012

January 16, 2015

ANSI/UL1479 (ASTM E814)	CAN/ULC S115
F Rating — 3 Hr	F Rating — 3 Hr
T Ratings - 0, 1/2 and 3/4 Hr (See Item 3)	FT Ratings - 0, 1/2 and 3/4 Hr (See Item 3)
	FH Rating — 3 Hr
	FTH Ratings - 0, 1/2 and 3/4 Hr (See Item 3)



SECTION A-A

1. **Floor Assembly —** The fire rated unprotected concrete and steel floor assembly shall be constructed of the materials and in the manner specified in the individual D900 Series designs in the UL Fire Resistance Directory and as summarized below.

A. **Concrete —** Min 2-1/2 in (64 mm) thick reinforced lightweight or normal weight (100-150 pcf or 1600-2400 kg/m^3) concrete.

B. **Steel Floor and Form Units* —** Composite or non-composite max 3 in. (76 mm) deep galv steel fluted units as specified in the individual Floor-Ceiling Design. Max diam of opening is 6 in. (152 mm).

2. **Steel Sleeve —** (Optional)- Nom 6 in. (152 mm) diam (or smaller) Schedule 40 (or heavier) steel sleeve cast or grouted into floor assembly, flush with floor surfaces.

3. **Cables —** Aggregate cross-sectional area of bundled cables in opening to be min 25 percent to max 45 percent of the cross-sectional area of the opening. Cables to be rigidly supported on both sides of the floor or wall assembly. Any combination of the following types and sizes of cables may be used.

A. Max 300 pair No. 24 AWG telecommunication cable with PVC insulation and jacket. **When telecommunication cable is used, T, FT and FTH Rating is 0 hr**

B. Max 500 kcmil single copper connector power cable with thermoplastic insulation and polyvinyl chloride (PVC) jacket. **When single copper conductor power cable is used, T, FT and FTH Rating is 0 hr**

C. Max 350 kcmil single connector power cable with either aluminum or copper conductors with cross-linked polyethylene (XLPE) insulation and polyvinyl chloride (PVC) jacket. **When single aluminum conductor power cable is used, T, FT and FTH Rating is 0 hr. When single copper conductor power cable is used, T Rating is 1/2 hr.**

D. Max three copper connector No. 6 AWG cable with polyvinyl chloride (PVC) insulation and jacket material. **When multi-connector power cable is used, T, FT and FTH Rating is 0 hr.**

E. Max 7/C copper connector No. 12 AWG multiconductor power and control cable with polyvinyl chloride (PVC) or cross-linked polyethylene (XLPE) insulation and PVC jacket. **When multi-connector power cable is used, T, FT and FTH Rating is 3/4 hr.**

F. Multiple fiber optical communication cable jacketed with PVC and having a max outside diameter of 1/2 in. **When fiber optic cable is used, T, FT and FTH Rating is 3/4 hr.**

G. Max 3/C No. 12 AWG with bare aluminum ground, polyvinyl chloride (PVC) insulated steel Metal-Clad cable+. **When MC cable is used, T, FT**

and FTH Rating is 0 hr.

4. **Firestop System —** The firestop system shall consist of the following:

A. **Packing Materials —** Min 2 in (51 mm) thickness of min 4 pcf (64 kg/m^3) mineral wool batt insualtion firmly packed into opening as a permanent form. Packing material to be recessed from top surface of floor to accommodate the required thickness of fill material.

B. **Fill, Void or Cavity Materials* - Sealant —** Min 1/2 in. (13 mm) thickness of fill material applied within the annulus, flush with top surface of floor.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — FS-ONE Sealant or FS-ONE MAX Intumescent Sealant

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ONLINE CERTIFICATIONS DIRECTORY

System No. HW-D-0029
XHBN.HW-D-0029
Joint Systems

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XHBN - Joint Systems

See General Information for Joint Systems

System No. HW-D-0029

April 07, 2015

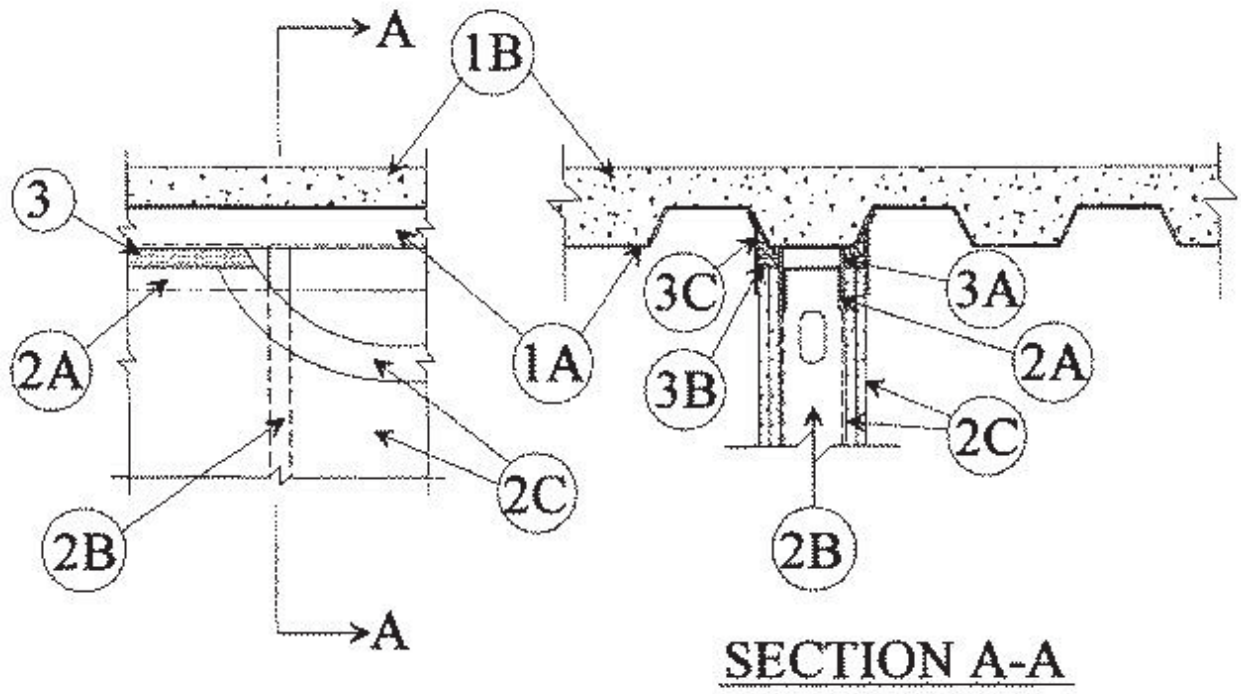
Assembly Ratings — 1 and 2 Hr (See Items 2 and 3B)

L Rating at Ambient — Less than 1 CFM/Lin Ft

L Rating at 400 F — Less than 1 CFM/Lin Ft

Nominal Joint Width — 1 In.

Class II Movement Capabilities — 25% Compression or Extension



1. **Floor Assembly —** The fire-rated fluted steel deck/concrete floor assembly shall be constructed of the materials and in the manner described in the individual D700 or D900 Series Floor-Ceiling Design in the UL Fire Resistance Directory and shall include the following construction features:

A. **Steel Floor And Form Units* —** Max 3 in. (76 mm) deep galv steel fluted floor deck .

A1. **Spray Applied Fire Resistive Material* —** (Optional, not shown) — Prior to the installation of the Deflective Channel, Forming Material and Fill, Void or Cavity Materials (Items 3A and 3B), the steel floor units may be sprayed with a min 5/16 in. (8 mm) to max 11/16 in. (18 mm) thickness of fire resistive material.

W R GRACE & CO - CONN — Type MK-6/HY.

B. **Concrete —** Min 2-1/2 in. (64 mm) thick reinforced concrete, as measured from the top plane of the floor units.

1A. **Roof Assembly —** (Not Shown)—As an alternate to the floor assembly, a fire rated fluted steel deck roof assembly may be used. The roof assembly shall be constructed of the materials and in the manner described in the individual P900 Series Roof-Ceiling Design in the UL Fire Resistance Directory. **The hourly rating of the roof assembly shall be equal to or greater than the hourly rating of the wall assembly.** The roof assembly shall include the following construction features:

A. **Steel Roof Deck —** Max 3 in. (76 mm) deep galv steel fluted roof deck.

B. **Roof Insulation —** Min 2-1/4 in. (57 mm) thick poured insulating concrete, as measured from the top plane of the floor units.

2. **Wall Assembly —** The 1 or 2 hr fire rated gypsum board/steel stud wall assembly shall be constructed of the materials and in the manner described in the individual U400 or V400- Series Wall and Partition Design in the UL Fire Resistance Directory and shall include the following construction features:

A. **Steel Floor And Ceiling Runners —** Floor and ceiling runners of wall assembly shall consist of galv steel channels sized to accommodate steel studs (Item 2B). When deflection channel (Item 3A) is used, ceiling runner to be provided with 3 in. (76 mm) flanges. Ceiling runner installed within the deflection channel with 1 in. (25 mm) gap maintained between the top of ceiling runner and top of deflection channel. When deflection channel is not used, flange height of ceiling runner shall be min 3/4 in. (19 mm) greater than nom joint width. Ceiling runner installed parallel to direction of fluted steel deck, centered beneath valley, and secured with steel masonry anchors or by welds spaced max 24 in. (610 mm) OC. When optional spray-applied fire resistive material is used on the steel deck and when deflection channel is not used, ceiling runner is secured through spray-applied material to valley of floor steel deck with min 3/16 in. (5 mm) diam steel masonry anchors spaced max 12 in. (305 mm) OC.

A1. **Light Gauge Framing*- Slotted Ceiling Runner —** As an alternate to the ceiling runner in Item 2A, slotted ceiling runner to consist of galv steel channel with slotted flanges sized to accommodate steel studs (Item 2B). Slotted ceiling runner installed parallel to direction of fluted steel deck, centered beneath valley, and secured with steel masonry anchors spaced max 24 in. (610 mm) OC. When slotted ceiling runner is used, deflection channel (Item 3A) shall not be used. When optional spray-applied fire resistive material is used on the steel floor slotted ceiling runner secured through spray-applied material to valley of steel deck with min 3/16 in. (5 mm) diam steel masonry anchors spaced max 12 in. (305 mm) OC.

BRADY CONSTRUCTION INNOVATIONS INC, DBA SLIPTRACK SYSTEMS — SLP-TRK

CALIFORNIA EXPANDED METAL PRODUCTS CO — CST

CLARKDIETRICH BUILDING SYSTEMS — Type SLT, SLT-H

MARINO/WARE, DIV OF WARE INDUSTRIES INC — Type SLT

SCAFCO STEEL STUD MANUFACTURING CO

STEELER INC — Steeler Slotted Ceiling Runner

TELLING INDUSTRIES L L C — True-Action Deflection Track

A2. **Light Gauge Framing —Floor and Ceiling Runners —** As an alternate to the ceiling and floor runners in Item 2A, 2A1 and 2A2, floor and ceiling runners to consist of galv steel channel sized to accommodate the **Light Gauge Framing* Slotted Stud** (Item 2B1) or **Light Gauge Framing* Slider C-Clip System** (Item 2B2). Floor and ceiling runners to be provided with min 1-1/4 in. and 3 in. (32 and 76 mm) flanges, respectively. Ceiling runner installed parallel to direction of steel deck, centered beneath valley, and secured with steel masonry anchors spaced

max 12 in. (305 mm) OC. When ceiling runner is used, deflection channel (Item 3A) shall not be used. When optional spray-applied fire resistive material is used on steel deck, ceiling runner secured through spray-applied material to valley of the steel deck with min 3/16 in. (5 mm) diam steel masonry anchors spaced max 12 in. (305 mm) OC.

STEELER INC — Floor and Ceiling Runners

A3. **Light Gauge Framing*- Notched Ceiling Runner —** As an alternate to the ceiling runners in Items 2A through 2A3, notched ceiling runners to consist of C-shaped galv steel channel with notched return flanges sized to accommodate steel studs (Item 2B). Notched ceiling runner installed parallel to direction of steel centered on valley, and secured with steel masonry anchors spaced max 24 in. (610 mm) OC. When notched ceiling runner is used, deflection channel (Item 3A) shall not be used. When optional spray-applied fire resistive material is used on the steel deck, notched ceiling runner secured through spray-applied material to valley of deck with min 3/16 in. (5 mm) diam steel masonry anchors spaced max 12 in. (305 mm) OC.

OLMAR SUPPLY INC — Type SCR

A4. **Light Gauge Framing* —Floor and Ceiling Runners —** As an alternate to the ceiling and floor runners in Item 2A, through 2A4, floor and ceiling runners to consist of galv steel channel sized to accommodate the **Light Gauge Framing* Steel Studs** (Item 2B3). Floor and ceiling runners to be provided with min 1-3/4 in. flanges. Ceiling runner installed parallel to direction of steel deck, centered beneath valley, and secured to valleys with steel masonry anchors spaced max 12 in. (305 mm) OC. When ceiling runner is used, deflection channel (Item 3A) shall not be used. When optional spray-applied fire resistive material is used on the steel deck, ceiling runner is secured through spray-applied material to each valley of steel deck with min 3/16 in. (5 mm) diam steel masonry anchors spaced max 12 in. (305 mm) OC.

CALIFORNIA EXPANDED METAL PRODUCTS CO — ViperTrack™

B. **Studs —** Steel studs to be min 3-1/2 in. (89 mm) wide. Studs cut 1/2 to 3/4 in. (13 to 19 mm) less in length than assembly height with bottom nesting in and resting on floor runner and with top nesting in ceiling runner without attachment. When slotted ceiling runner (Item 2A1) is used, steel studs secured to slotted ceiling runner with No. 8 by 1/2 in. (13 mm) long wafer head steel screws at midheight of slot on each side of wall. Stud spacing not to exceed 24 in. (610 mm) OC.

B1. **Light Gauge Framing* —Slotted Studs —** Slotted steel stud to be used in conjunction with **Light Gauge Framing* —Floor and Ceiling Runners** (Item 2A3). Slotted steel studs to be min 3-1/2 in. (89 mm) wide. Slotted studs cut 1 in. (25 mm) less in length than assembly height with bottom nesting in and secured to both ceiling and floor runners. Ceiling runner secured to preformed slot within steel stud by means of No. 10 by 3/4 in. (19 mm) long low profile head steel screw. Floor runner attached to bottom of steel stud by means of No. 8 by 1/2 in. (13 mm) long pan head steel screw. Slotted stud spacing not to exceed 24 in. (610 mm) OC.

STEELER INC — Slotted Stud

B2. **Light Gauge Framing* —Slider C-Clip System —** As an alternate to the **Light Gauge Framing* —Slotted Steel Studs** (Item 2B1), a Slider C-Clip System consisting of a C shaped steel clip with a slotted opening and a steel stud to be used in conjunction with **Light Gauge Framing —Floor and Ceiling Runners** (Item 2A3). Steel clips and studs to be min 3-1/2 in. (89 mm) wide. Steel clip inserted into inside flange of steel stud without attachment. Total length of steel stud cut 1 in. (25 mm) less than assembly height with bottom of steel stud nesting in and secured to floor runner. Floor runner attached to bottom of steel stud by means of No. 8 by 1/2 in. (13 mm) long pan head steel screw. Ceiling runner secured to steel C-Clip by means of No. 10 by 3/4 in. (19 mm) long pan head steel screw located 3/8 in. (10 mm) below top of ceiling runner. Top row of gypsum board screws shall be centered within the preformed slot of the C-Clip. Steel stud and steel clips spacing not to exceed 24 in. (610 mm) OC.

STEELER INC — Slider C Clip System

B3. **Light Gauge Framing* — Steel Studs —** Steel Studs to be used in conjunction with **Light Gauge Framing* —Floor and Ceiling Runners** (Item 2A5). Steel studs to be min 3-5/8 in. (92 mm) wide. Studs cut 1/2 to 3/4 in. (13 to 19 mm) less in length than assembly height with bottom nesting in and resting on floor runner and with top nesting in ceiling runner without attachment. When slotted ceiling runner (Item 2A1) is used, steel studs secured to slotted ceiling runner with No. 8 by 1/2 in. (13 mm) long wafer head steel screws at midheight of slot on each side of wall. Stud spacing not to exceed 24 in (610 mm) OC.

CALIFORNIA EXPANDED METAL PRODUCTS CO — ViperStud™

C. **Gypsum Board* —** Gypsum board sheets installed to a min total thickness of 5/8 in. and 1-1/4 in. (16 and 32 mm) on each side of wall for 1 and 2 hr rated assemblies, respectively. Wall to be constructed as specified in the individual Wall and Partition Design in the UL Fire Resistance Directory, except that a nom 1 in. (25 mm) gap shall be maintained between the top of the gypsum board and the bottom of the steel floor or roof deck and the top row of screws shall be installed into the studs 3-1/2 in. (89 mm) below the lower surface of the floor. **The hourly rating of the joint system is equal to the hourly fire rating of the wall.**

3. **Joint System — Max separation between bottom of floor or roof and top of wall is 1 in. (25 mm). The joint system is designed to accommodate a max 25 percent compression or extension from its installed width.** The joint system consists of an optional deflection channel, forming material and a fill material, as follows:

A. **Deflection Channel - (Optional) —** A nom 3-5/8 in. (92 mm) wide by 3 in. (76 mm) deep min 24 ga steel U-shaped channel. Deflection channel installed parallel to direction of steel deck, centered beneath valley and secured with steel masonry anchors or by welds spaced max 24 in. (610 mm) OC. When optional spray- applied fire resistive material is used on the steel deck, deflection channel secured through spray- applied material to valley of steel deck with min 1-1/2 in. (38 mm) long by min 3/16 in. (5 mm) diam steel masonry anchors spaced a max 24 in. (610 mm) OC . The ceiling runner (Item 2A) is installed within the deflection channel to maintain a 1 in. (25 mm) gap between the top of the ceiling runner and the top of the deflection channel. The ceiling runner is not fastened to the deflection channel.

B. **Forming Material* —** Min 4 pcf (64 kg/m^3) mineral wool batt insulation to be cut a min of 20 percent wider than the gap between the top of the gypsum board and bottom of the steel floor or roof deck . The mineral wool is to be compressed and firmly packed into the gap between the top of the gypsum board and bottom of the steel floor or roof deck on both sides of the wall and shall be min 3/4 in. (19 mm) thick for 1 hr Rated Design and min 1-1/2 in. (38 mm) thick for 2 hr Rated Design.

IIG MINWOOL L L C — MinWool-1200 Safing

ROCK WOOL MANUFACTURING CO — Delta Board or Delta-8

ROCKWOOL MALAYSIA SDN BHD — Type Safe

ROXUL INC — Type Safe

THERMAFIBER INC — Type SAF

C. **Fill, Void or Cavity Material* —** Min 1/16 in. (1.6 mm) dry thickness (1/8 in. or 3.2 mm wet thickness) of fill material sprayed or brushed on each side of the wall between the top of the gypsum board and the bottom of the steel floor or roof deck to completely cover mineral wool and overlap a min of 1/2 in. (13 mm) onto gypsum board and steel deck on both sides of wall. When the steel deck is coated with spray applied Material (Item A1), the fill material shall overlap min 2 in. (51 mm) onto the spray applied material.

3M COMPANY — Fire Dam™ Spray 200

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Last Updated on 2015-04-07

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ONLINE CERTIFICATIONS DIRECTORY

System No. W-L-7001
XHEZ.W-L-7001
Through-penetration Firestop Systems

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XHEZ - Through-penetration Firestop Systems

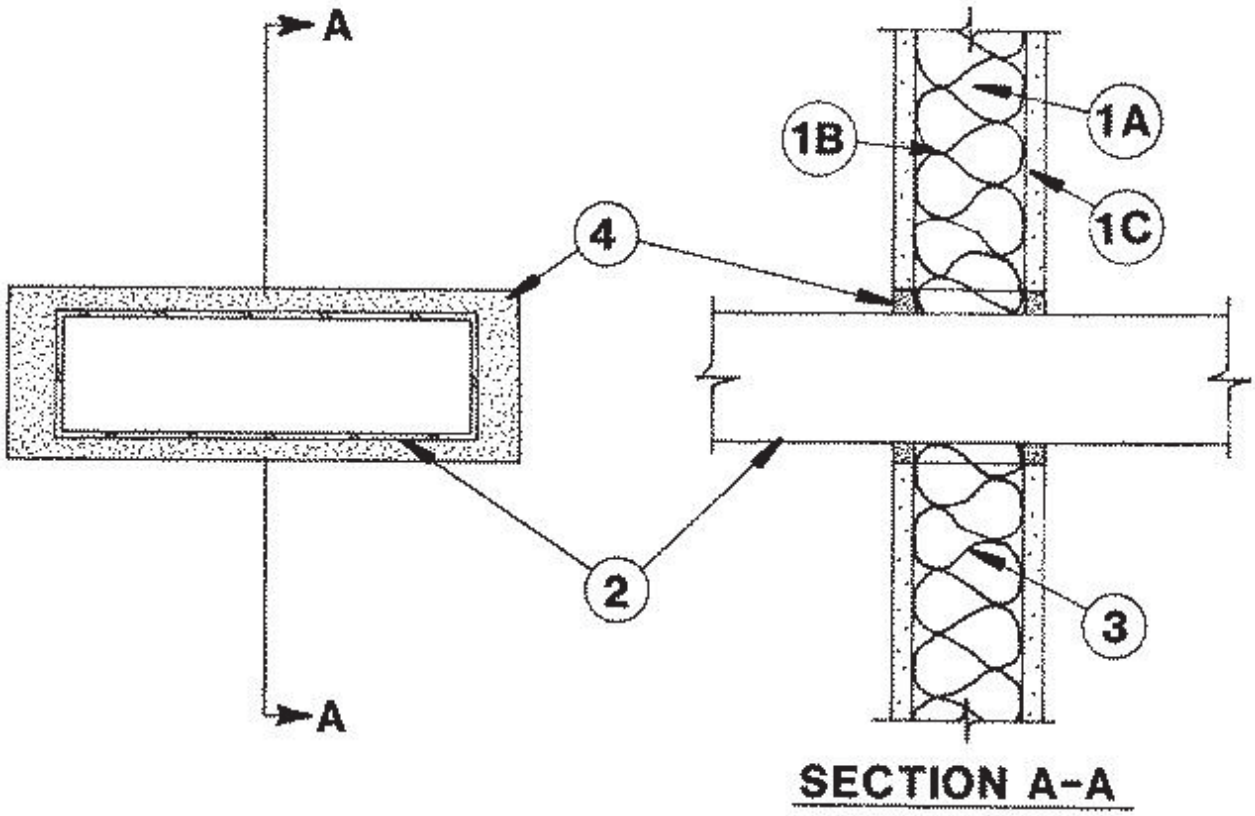
See General Information for Through-penetration Firestop Systems

System No. W-L-7001

May 01, 1997

F Rating — 1 Hr

T Rating — 0 Hr



1. **Wall Assembly —** The fire-rated gypsum wallboard/stud wall assembly shall be constructed of the materials and in the manner described in the individual U300 or U400 Series Wall and Partition Designs in the UL Fire Resistance Directory and shall include the following construction features:

A. **Studs —** Wall framing may consist of either wood studs or steel channel studs. Wood studs to consist of nom 2 by 4 in. lumber spaced 16 in. OC. Steel studs to be min 2-1/2 in. wide and spaced max 24 in. OC.

B. **Batts and Blankets* —** Nom 1-1/2 in. thick glass fiber batts friction fitted to fill interior of stud cavities.

C. **Gypsum Board* —** The gypsum wallboard type, thickness, number of layers and orientation shall be as specified in the individual wall and partition Design. Max area of opening is 48 sq in. with max dimension of 12 in.

2. **Air Duct —** Prefabricated 24 MSG sheet metal air duct. Max cross sectional area of duct is 30 sq in. with max dimension of 10 in. A min 7/16 to max 1-5/8 in. annular space is required within the firestop system. Air duct to be rigidly supported on both sides of wall assembly.

3. **Forming Material* —** Min 2-1/2 in. thickness of min 3.5 pcf mineral wool batt insulation firmly packed into opening as a permanent form. Forming material to be recessed from both surfaces of wall to accommodate the required thickness of fill material.

THERMAFIBER INC — Type SAF

4. **Fill, Void or Cavity Material* — Sealant —** Min 1/2 in. thickness of fill material applied within the annulus, flush with both surfaces of wall. Dry mix material mixed with water at a rate of 2.1 parts dry mix to 1 lb part water by weight in accordance with the accompanying installation instructions.

UNITED STATES GYPSUM CO — Type FC

4A. **Fill, Void or Cavity Material* —** Not Shown — Two component fill material used as an alternate to Item 4. Min 1/2 in. thickness of fill material applied within the annulus, flush with both surfaces of wall. Ready-mixed component mixed with accelerator component at a rate of 66 parts of ready-mixed component to 1 part of accelerator component by weight in accordance with the accompanying installation instructions.

UNITED STATES GYPSUM CO — Type RFC

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Last Updated on 1997-05-01

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ONLINE CERTIFICATIONS DIRECTORY

System No. W-L-1054
XHEZ.W-L-1054
Through-penetration Firestop Systems

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XHEZ - Through-penetration Firestop Systems

XHEZ7 - Through-penetration Firestop Systems Certified for Canada

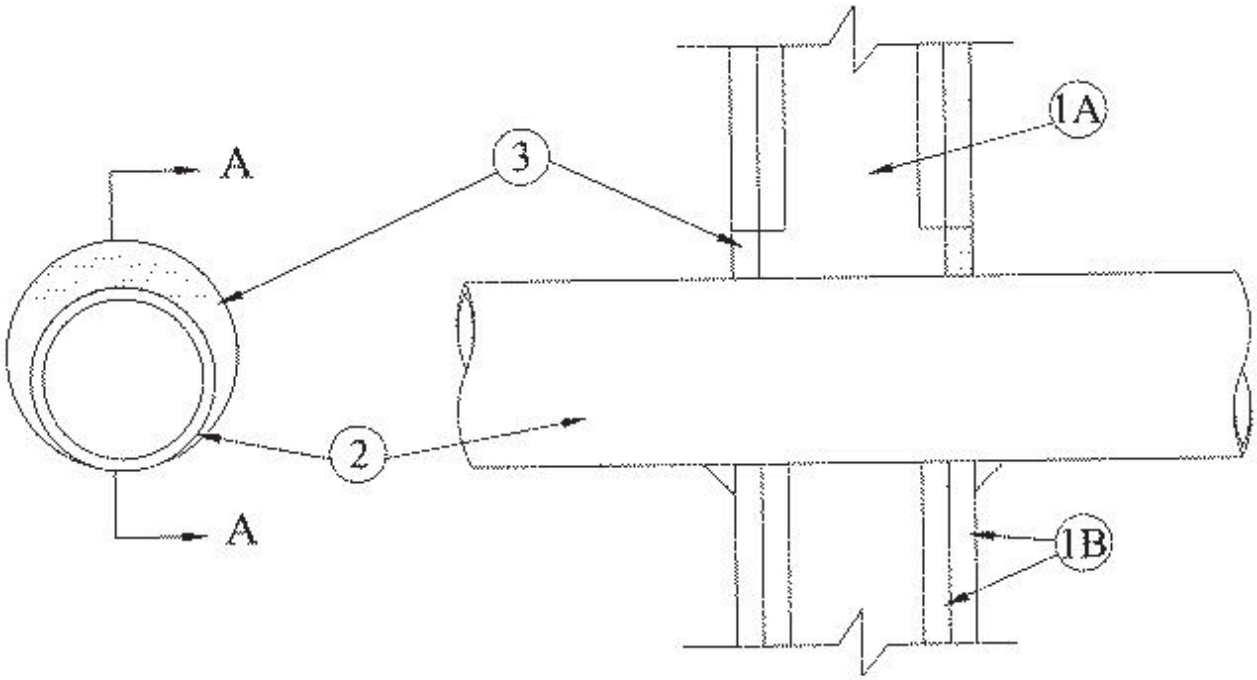
See General Information for Through-penetration Firestop Systems

See General Information for Through-penetration Firestop Systems Certified for Canada

System No. W-L-1054

January 23, 2015

ANSI/UL1479 (ASTM E814)	CAN/ULC S115
F Ratings —1 and 2 Hr (See Items 1 and 3)	F Ratings — 1 and 2 Hr (See Items 1 and 3)
T Rating — 0 Hr	FT Rating — 0 Hr
L Rating at Ambient — Less Than 1 CFM/sq ft	FH Ratings —1 and 2 Hr (See Items 1 and 3)
L Rating at 400 F — Less Than 1 CFM/sq ft	FTH Rating — 0 Hr
	FTH Rating — 0 Hr L Rating at Ambient — Less Than 1 CFM/sq ft
	L Rating at 400 F — Less Than 1 CFM/sq ft



SECTION A-A

1. **Wall Assembly —** The 1 or 2 hr fire-rated gypsum wallboard/stud wall assembly shall be constructed of the materials and in the manner specified in the individual U300 or U400 Series Wall and Partition Designs in the UL Fire Resistance Directory and shall include the following construction features:

A. **Studs —** Wall framing may consist of either wood studs or steel channel studs. Wood studs to consist of nom 2 by 4 in. (51 by 102 mm) lumber spaced 16 in. (406 mm) OC. Steel studs to be min 2-1/2 in. (64 mm) wide and spaced max 24 in. (610 mm) OC. When steel studs are used and the diam of opening exceeds the width of stud cavity, the opening shall be framed on all sides using lengths of steel stud installed between the vertical studs and screw-attached to the steel studs at each end. The framed opening in the wall shall be 4 to 6 in. (102 to 152 mm) wider and 4 to 6 in. (102 to 152 mm) higher than the diam of the penetrating item such that, when the penetrating item is installed in the opening, a 2 to 3 in. (51 to 76 mm) clearance is present between the penetrating item and the framing on all four sides.

B. **Gypsum Board* —** 5/8 in. (16 mm) thick, 4 ft (122 cm) wide with square or tapered edges. The gypsum board type, thickness, number of layers, fastener type and sheet orientation shall be as specified in the individual U300 or U400 Series Design in the UL Fire Resistance Directory. Max diam of opening is 32-1/4 in. (819 mm) for steel stud walls. Max diam of opening is 14-1/2 in. (368 mm) for wood stud walls.

The F and FH Ratings of the firestop system are equal to the fire rating of the wall assembly.

2. **Through-Penetrants —** One metallic pipe, conduit or tubing to be installed either concentrically or eccentrically within the firestop system. The annular space shall be min 0 in. to max 2-1/4 in. (57 mm). Pipe may be installed with continuous point contact. Pipe, conduit or tubing may be installed at an angle not greater than 45 degrees from perpendicular. Pipe, conduit or tubing to be rigidly supported on both sides of wall assembly. The following types and sizes of metallic pipes, conduits or tubing may be used:

A. **Steel Pipe —** Nom 30 in. (762 mm) diam (or smaller) Schedule 10 (or heavier) steel pipe.

B. **Iron Pipe —** Nom 30 in. (762 mm) diam (or smaller) cast or ductile iron pipe.

C. **Conduit —** Nom 4 in. (102 mm) diam (or smaller) steel electrical metallic tubing or 6 in. (152 mm) . diam steel conduit.

D. **Copper Tubing —** Nom 6 in. (152 mm) diam (or smaller) Type L (or heavier) copper tubing.

E. **Copper Pipe —** Nom 6 in. (152 mm) diam (or smaller) regular (or heavier) copper pipe.

3. **Fill, Void or Cavity Material* — Sealant —** Min 5/8 in. (16 mm) thickness of fill material applied within the annulus, flush with both surfaces of wall. At the point or continuous contact locations between pipe and wall, a min 1/2 in. (13 mm) diam bead of fill material shall be applied at the pipe wall interface on both surfaces of wall.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — FS-One Sealant or FS-ONE MAX Intumescent Sealant

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Last Updated on 2015-01-23

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ONLINE CERTIFICATIONS DIRECTORY

System No. W-L-1085
XHEZ.W-L-1085
Through-penetration Firestop Systems

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XHEZ - Through-penetration Firestop Systems

XHEZ7 - Through-penetration Firestop Systems Certified for Canada

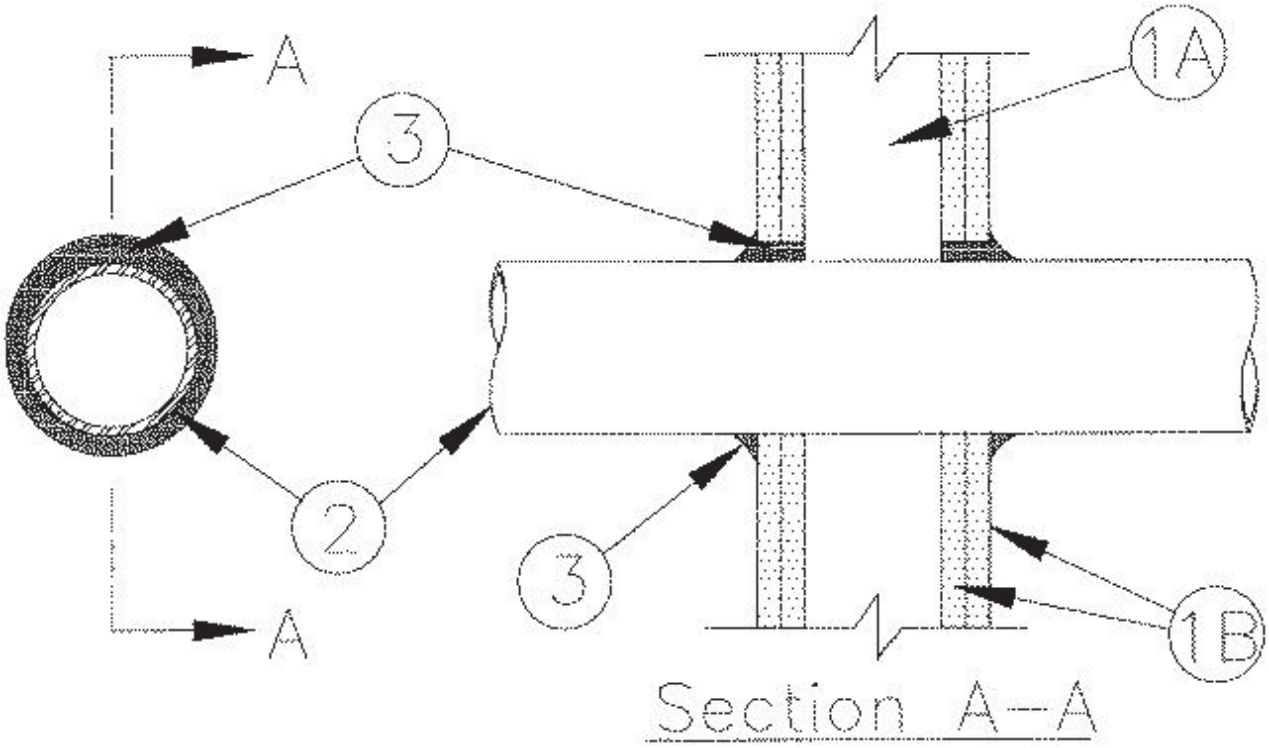
See General Information for Through-penetration Firestop Systems

See General Information for Through-penetration Firestop Systems Certified for Canada

System No. W-L-1085

January 23, 2015

ANSI/UL1479 (ASTM E814)	CAN/ULC S115
F Rating — 1 and 2 Hr (See Item 1B)	F Rating — 1 and 2 Hr (See Item 1B)
T Rating — 0 Hr	FT Rating — 0 Hr
L Rating At Ambient — Less Than 1 CFM/sq ft	FH Rating — 1 and 2 Hr (See Item 1B)
L Rating At 400 F — 4 CFM/sq ft	FTH Rating — 0 Hr



1. **Wall Assembly —** The 1 or 2 hr fire-rated gypsum wallboard/stud wall assembly shall be constructed of the materials and in the manner specified in the individual U300 or U400 Series Wall and Partition Designs in the UL Fire Resistance Directory and shall include the following construction features:

A. **Studs —** Wall framing may consist of either wood studs or steel channel studs. Wood studs to consist of nom 2 by 4 in. (51 by 102 mm) lumber spaced 16 in. (406 mm) OC. Steel studs to be min 2-1/2 in. (64 mm) wide and spaced max 24 in. (610 mm) OC.

B. **Gypsum Board* —** 5/8 in. (16 mm) thick, 4 ft (122 cm) wide with square or tapered edges. The gypsum wallboard type, number of layers, fastener type and sheet orientation shall be as specified in the individual Wall and Partition Design. Max diam of opening is 13-1/4 in. (337 mm).

Diam of circular opening cut through gypsum wallboard on each side of wall assembly to be min 1/4 in. (6 mm) to max 1/2 in. (13 mm) larger than outside diam of through penetrant (Item 2).

The hourly F and FH Ratings of the firestop system are equal to the hourly fire rating of the wall assembly in which it is installed.

2. **Through Penetrants —** One metallic pipe, conduit or tubing to be installed either concentrically or eccentrically within the firestop system. Pipe, conduit or tubing to be rigidly supported on both sides of wall assembly. The annular space between the through-penetrant and the periphery of the opening shall be min 0 in. to max 1/4 in. (6 mm). The following types and sizes of metallic pipes, conduits or tubing may be used:

A. **Steel Pipe —** Nom 12 in. (305 mm) diam (or smaller) Schedule 10 (or heavier) steel pipe.

B. **Iron Pipe —** Nom 12 in. (305 mm) diam (or smaller) cast or ductile iron pipe.

C. **Conduit —** Nom 6 in. (152 mm) diam (or smaller) steel electrical metallic tubing or steel conduit.

D. **Copper Tubing —** Nom 6 in. (152 mm) diam (or smaller) Type L (or heavier) copper tubing.

E. **Copper Pipe —** Nom 6 in. (152 mm) diam (or smaller) Regular (or heavier) copper pipe.

3. **Fill, Void or Cavity Material* — Sealant —** Fill material to be forced into the annulus to maximum extent possible. Additional fill material to be installed such that a min 1/2 in. (13 mm) crown is formed around the penetrating item and lapping 1/4 in. (6 mm) beyond the periphery of the opening.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — FS-One Sealant, FS-ONE MAX Intumescent Sealant

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ONLINE CERTIFICATIONS DIRECTORY

System No. W-L-1092
XHEZ.W-L-1092
Through-penetration Firestop Systems

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XHEZ - Through-penetration Firestop Systems

XHEZ7 - Through-penetration Firestop Systems Certified for Canada

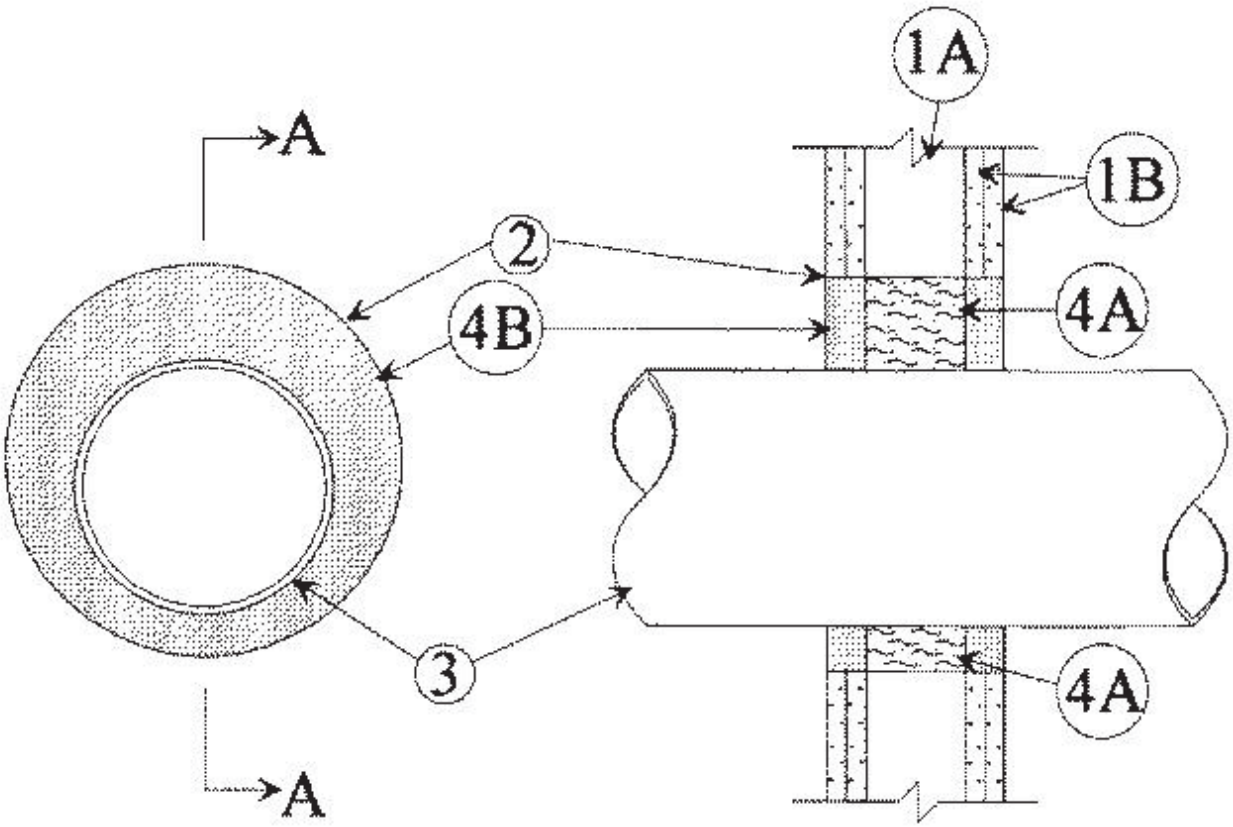
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See General Information for Through-penetration Firestop Systems Certified for Canada

System No. W-L-1092

January 23, 2015

ANSI/UL1479 (ASTM E814)	CAN/ULC S115
F Ratings — 1 & 2 Hr (See Item 1)	F Ratings — 1 & 2 Hr (See Item 1)
T Ratings — 0 & 1/4 Hr (See Item 1)	FT Ratings— 0 & 1/4 Hr (See Item 1)
	FH Ratings — 1 & 2 Hr (See Item 1)
	FTH Ratings — 0 & 1/4 Hr (See Item 1)



SECTION A-A

1. **Wall Assembly —** The 1 or 2 hr fire-rated gypsum wallboard/stud wall assembly shall be constructed of the materials and in the manner specified in the individual U300, U400 or V400 Series Wall and Partition Designs in the UL Fire Resistance Directory and shall include the following construction features:

A. **Studs —** Wall framing may consist of either wood studs or steel channel studs. Wood studs to consist of nom 2 by 4 in. (51 by 102 mm) lumber spaced 16 in. (406 mm) OC. Steel studs to be min 3-1/2 in. (89 mm) wide and spaced max 24 in. (610 mm) OC.

B. **Gypsum Board* —** 5/8 in. (16 mm) thick, 4 ft wide with square or tapered edges. The gypsum wallboard type, thickness, number of layers, fastener type and sheet orientation shall be as specified in the individual Wall and Partition Design. Max diam of opening is 10 in. (254 mm).

The hourly F, FH Ratings are equal to the hourly fire rating of the wall assembly. The hourly T, FT, FTH Ratings are 0 and 1/4 hr for 1 and 2 hr rated wall assemblies, respectively.

2. **Steel Sleeve —** Max 10 in. (254 mm) diam cylindrical sleeve fabricated from min 0.016 in. thick (28 gauge) galv sheet steel and having a min 2 in. (51 mm) lap along the longitudinal seam. Length of steel sleeve to be equal to thickness of wall. Sleeve installed by coiling the sheet steel to a diam smaller than the through opening, inserting the coil through the openings and releasing the coil to let it uncoil against the circular cutouts in the gypsum wallboard layers. Sleeve may also be formed of No. 8 steel wire mesh having a min 1 in. (25 mm) lap along the longitudinal seam.

3. **Through Penetrants —** One metallic pipe or conduit or tubing to be installed either concentrically or eccentrically within the firestop system. Pipe or conduit to be rigidly supported on both sides of wall assembly. The annular space between pipe or conduit and periphery of opening shall be 1 in. to 2-3/8 in. (25 to 60 mm). The following types and sizes of metallic pipes or conduits may be used:

A. **Steel Pipe —** Nom 6 in. (152 mm) diam (or smaller) Schedule 10 (or heavier) steel pipe.

B. **Conduit —** Nom 4 in. (102 mm) diam (or smaller) steel electrical metallic tubing or conduit.

C. **Steel Pipe —** Nom 4 in. (102 mm) diam (or smaller) Schedule 7 (or heavier) steel pipe.

4. **Firestop System —** The firestop system shall consist of the following:

A. **Packing Material —** Min 1-1/4 in. or 2-1/2 in. (32 or 64 mm) thickness of mineral wool batt insulation for 1 and 2 hr assemblies, respectively, firmly packed into steel sleeve on both sides of the wall assembly as permanent forms. Packing material to be recessed from both surfaces of wall as required to accommodate the required thickness of fill material.

B. **Fill, Void or Cavity Material — Sealant* —** Min 1-1/4 in. (32 mm) thickness applied within

steel sleeve, flush with both surfaces of wall.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — CFS-S SIL GG, FS-ONE Sealant or FS-ONE MAX Intumescent Sealant

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ONLINE CERTIFICATIONS DIRECTORY

System No. W-L-1175
XHEZ.W-L-1175
Through-penetration Firestop Systems

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XHEZ - Through-penetration Firestop Systems

See General Information for Through-penetration Firestop Systems

System No. W-L-1175

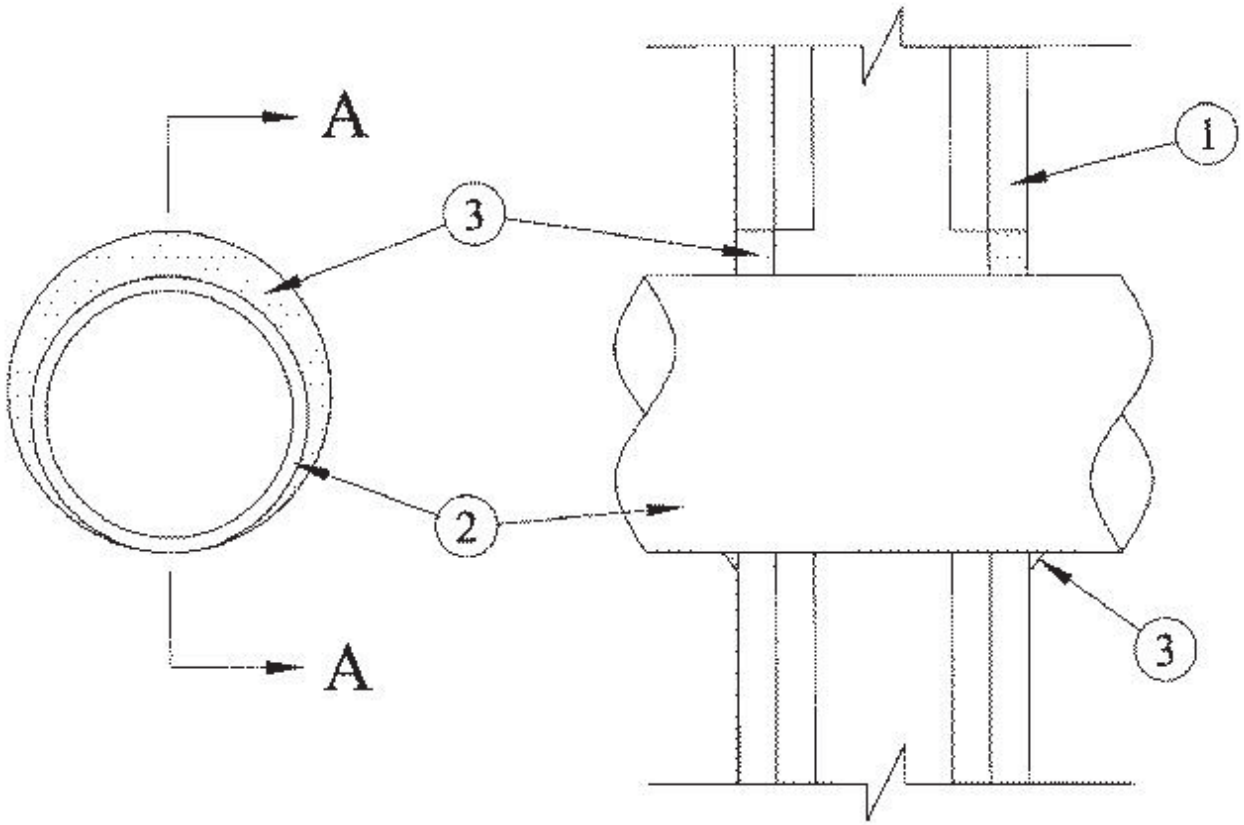
February 08, 2006

F Ratings — 1 and 2 Hr (See Item 1)

T Rating — 0 Hr

L Rating at Ambient — Less Than 1 CFM/sq ft

L Rating at 400 F — Less Than 1 CFM/sq ft



SECTION A-A

1. **Wall Assembly —** The 1 or 2 hr fire rated wallboard/stud wall assembly shall be constructed of the materials and in the manner specified in the individual U300 or U400 Series Wall and Partition Designs in the UL Fire Resistance Directory and shall include the following construction features.

A. **Studs —** Wall framing shall consist of either wood studs or steel channel studs. Wood studs to consist of nom 2 by 4 in. lumber spaced 16 in. OC. Steel studs to be min 2-1/2 in. wide and spaced max 24 in. OC.

B. **Gypsum Board* —** Nom 5/8 in. thick, 4 ft wide with square or tapered edges. The gypsum wallboard type, thickness, number of layers, fastener type and sheet orientation shall be as specified in the individual U300 or U400 Series Design in the Fire Resistance Directory. Max diam of opening is 5-1/2 in.

The hourly F and T Ratings of the firestop system is equal to the hourly fire rating of the wall assembly in which it is installed.

2. **Through Penetrant —** One metallic tubing or conduit installed concentrically or eccentrically within the firestop system. Tube or conduit to be rigidly supported on both sides of wall assembly. The annular space between the tube or conduit and periphery of the steel sleeve shall be min 0 in. (point contact) to max 1 in. The following types and sizes of metallic tube or conduit may be used:

A. **Conduit —** Nom 4 in. diam (or smaller) steel electrical metallic tubing or steel conduit.

3. **Fill Void or Cavity Material* — Putty —** Min 5/8 in. thickness of fill material applied within the annulus, flush with both surfaces of wall. At point contact location between penetrant and wall, a 1/4 in. crown of fill material shall be applied at the conduit/wall interface on both sides of the assembly, lapping 1/4 in. on the conduit and 1/4 in. beyond the periphery of the opening.

HILTI INC — CP618 Putty Stick

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ONLINE CERTIFICATIONS DIRECTORY

System No. W-L-1214
XHEZ.W-L-1214
Through-penetration Firestop Systems

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XHEZ - Through-penetration Firestop Systems

XHEZ7 - Through-penetration Firestop Systems Certified for Canada

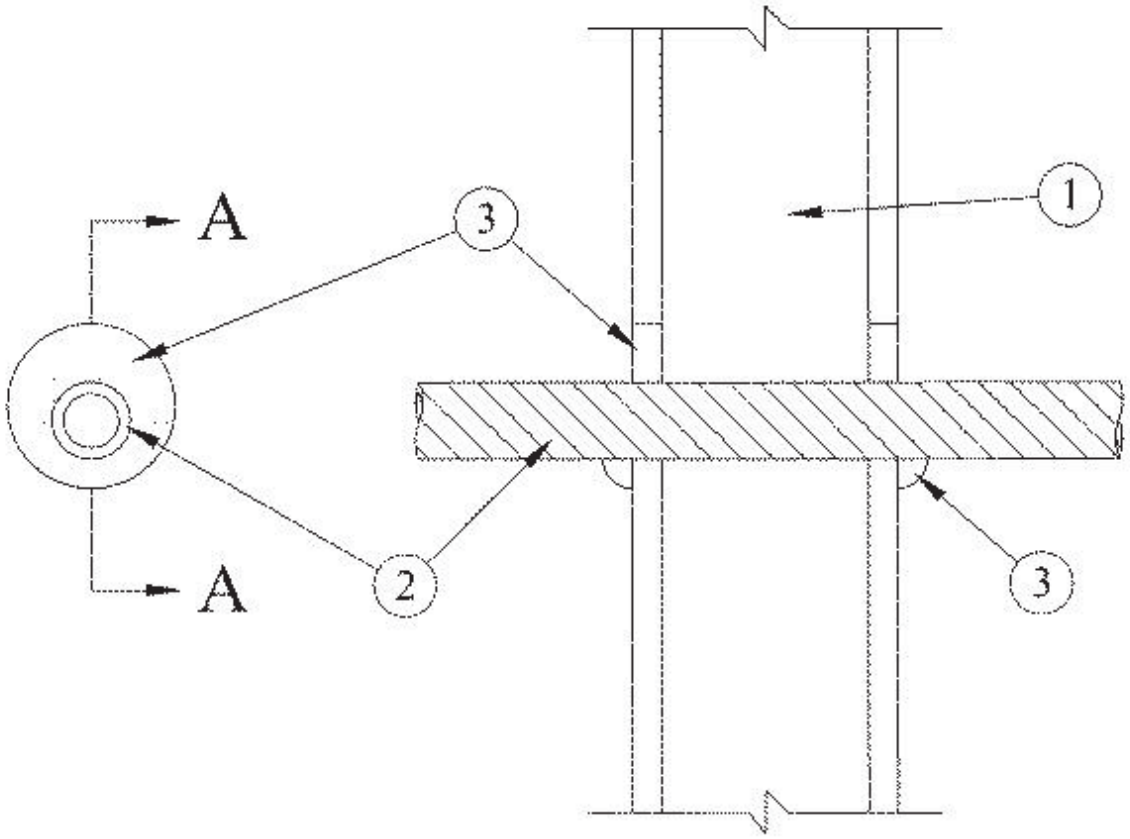
See General Information for Through-penetration Firestop Systems

See General Information for Through-penetration Firestop Systems Certified for Canada

System No. W-L-1214

January 22, 2015

ANSI/UL1479 (ASTM E814)	CAN/ULC S115
F Rating — 1 Hr	F Rating —1 Hr
T Rating — 0 Hr	FT Rating — 0 Hr
	FH Rating — 1 Hr
	FTH Rating — 0 Hr



SECTION A-A

1. **Wall Assembly —** The fire-rated gypsum wallboard/stud wall assembly shall be constructed of the materials and in the manner specified if the individual U300, U400, V400 or W400 Series Wall and Partition Designs in the Fire Resistance Directory and shall include the following construction features:

A. **Studs —** Wall framing shall consist of either wood studs or channel shaped steel studs. Wood studs to consist of 2 by 4 in. (51 by 102 mm) lumber spaced 16 in. (406 mm) OC. Steel studs to be min 2-1/2 in. (64 mm) wide, fabricated from min 25 MSG galvanized steel, spaced max 24 in. (610 mm) OC.

B. **Wallboard, Gypsum* —** One layer of nom 5/8 in. (16 mm) gypsum wallboard, as specified in the individual Wall and Partition Design. Max diam of opening is 2 in. (51 mm).

2. **Through Penetrants — Flexible Steel Conduit+ —** Nom 1 in. (25 mm) diam (or smaller) flexible steel conduit. Max one conduit to be installed either concentrically or eccentrically within the firestop system. The annular space between pipe and periphery of opening shall be min 0 in. (0 mm, point contact) to max 3/4 in. (19 mm). Conduit to be rigidly supported on both sides of floor or wall assembly.

See **Flexible Metal Conduit** (DXUZ) category in the Electrical Construction Materials Directory for names of manufacturers.

3. **Fill, Void or Cavity Material* — Sealant —** Min 5/8 in. (16 mm) thickness of fill material applied within annulus flush with both surfaces of wall. At point contact location between conduit and wall, a min 1/2 in. (13 mm) bead of fill material shall be applied at the conduit/wallboard interface on both side of wall.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — FS-ONE Sealant or FS-ONE MAX Intumescent Sealant

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ONLINE CERTIFICATIONS DIRECTORY

System No. W-L-1247
XHEZ.W-L-1247
Through-penetration Firestop Systems

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XHEZ - Through-penetration Firestop Systems

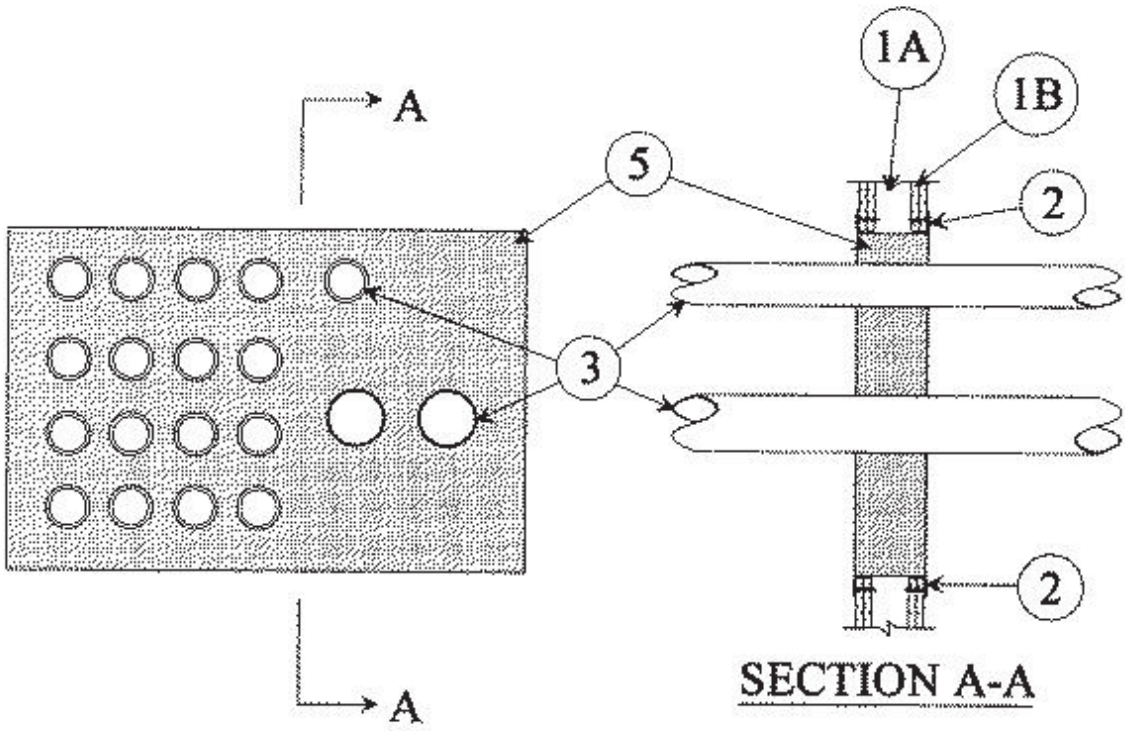
See General Information for Through-penetration Firestop Systems

System No. W-L-1247

May 22, 2001

F Rating — 2 Hr

T Rating — 0 Hr



1. **Wall Assembly —** The fire-rated gypsum wallboard/stud wall assembly shall be constructed of the materials and in the manner specified in the individual U300 or U400 Series Wall and Partition Designs in the UL Fire Resistance Directory and shall include the following construction features:

A. **Studs —** Wall framing may consist of either wood studs or steel channel studs. Wood studs to consist of nom 2 by 4 in. lumber spaced 16 in. OC. Steel studs to be min 2-1/2 in. wide and spaced max 24 in. OC. Additional framing members to be installed in stud cavity containing the through penetrating item to form a rectangular box around the penetrants.

B. **Gypsum Board* —** Two layers of nom 5/8 in. thick gypsum wallboard, as specified in the individual Wall and Partition Design. Max area of opening is 1024 sq in. with max dimension of 32 in. for steel stud walls. Max width of opening in wood stud walls is limited to 14-1/2 in.

2. **Angle Clips —** Nom 1-1/2 in. by 1-1/2 in. by No. 22 gauge (or heavier) steel angles attached to all four sides of the opening on both sides of the wall. The angle shall be attached to the wall with min 1-5/8 in. long Type S self-drilling, self-tapping bugle-head steel screws spaced max of 2 in. from each end and at a max of 5 in. OC.

3. **Through Penetrants —** The space between pipes, conduits or tubing shall be min 1 in. when diam of through penetrant is 1-1/2 in. or smaller and 2-1/2 in. when diam of through penetrant is larger than 1-1/2 in. The space between pipes, conduits or tubing and periphery of opening shall be min 1 in. when diam of through penetrant is 1-1/2 in. or smaller and 2-1/2 in. when diam of through penetrant is larger than 1-1/2 in. Pipe, conduit or tubing to be rigidly supported on both sides of wall assembly. The following types and sizes of metallic pipes, conduits or tubing may be used:

A. **Steel Pipe —** Nom 6 in. diam (or smaller) Schedule 10 (or heavier) steel pipe.

B. **Iron Pipe —** Nom 6 in. diam (or smaller) cast or ductile iron pipe.

C. **Conduit —** Nom 6 in. diam (or smaller) steel conduit or nom 4 in. diam (or smaller) steel electrical metallic tubing.

D. **Copper Tubing —** Nom 3 in. diam (or smaller) Type L (or heavier) copper tubing.

E. **Copper Pipe —** Nom 3 in. diam (or smaller) Regular (or heavier) copper pipe.

4. **Forms —** (Not Shown) — Used as a form to prevent leakage of fill material during installation. Forms to be a rigid sheet material, cut to fit the contour of the penetrating items and fastened to both sides of wall. Forms to be removed after fill material has cured.

5. **Fill, Void or Cavity Material*—Mortar —** Min 4-1/2 in. thickness of fill material applied within the annulus, centered within the wall. Mortar is mixed at a rate of 2-1/2 parts dry mix to one part water by volume in accordance with the fill material manufacturer's installation instructions.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — CP637 Mortar

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ONLINE CERTIFICATIONS DIRECTORY

System No. W-L-1249
XHEZ.W-L-1249
Through-penetration Firestop Systems

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XHEZ - Through-penetration Firestop Systems

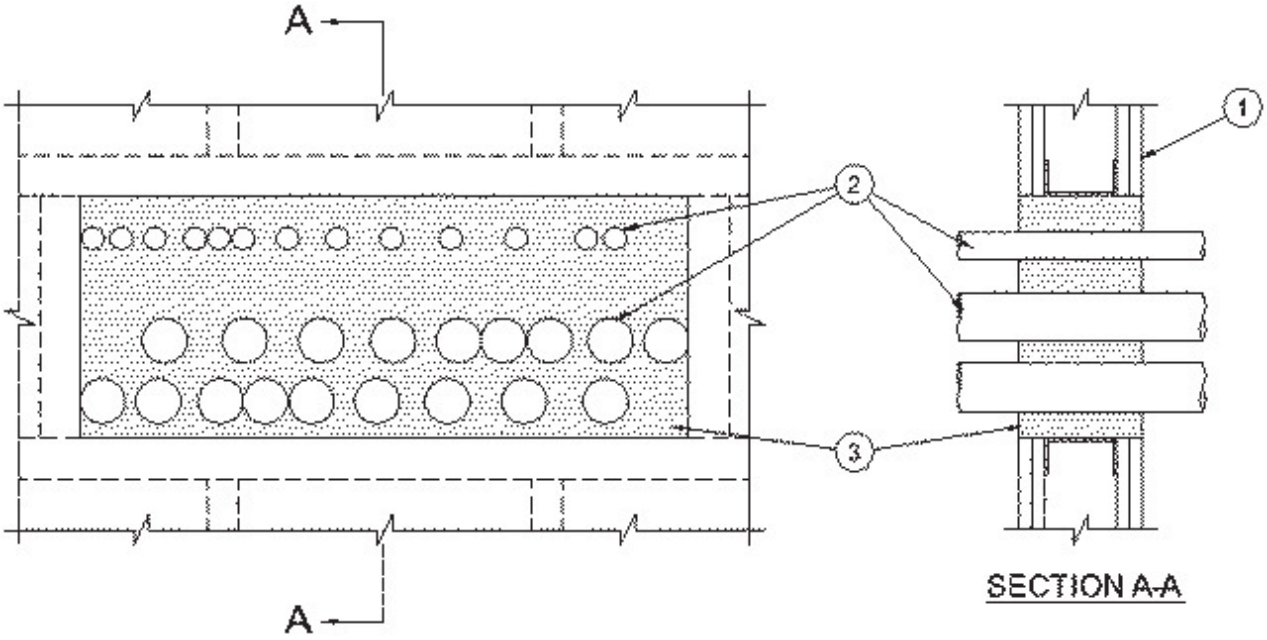
See General Information for Through-penetration Firestop Systems

System No. W-L-1249

December 07, 2001

F Ratings — 1 and 2 Hr (See Items 1 and 3)

T Rating — 1/2 Hr



1. **Wall Assembly —** The 1 or 2 hr fire-rated gypsum board/stud wall assembly shall be constructed of the materials and in the manner described in the individual U400 Series Wall or Partition Design in the UL Fire Resistance Directory and shall include the following construction features.

A. **Studs —** Steel studs 3-1/2 in. deep, fabricated from 25 MSG galv steel, spaced max 24 in. OC.

B. **Gypsum Boards* —** The gypsum board type, number of layers, fastener type and sheet orientation shall be as specified in the individual Wall and Partition Design. Max area of opening is 360 sq in. with max dimension of 30 in.

The hourly F Rating of the firestop system is equal to the hourly fire rating of the wall assembly in which it is installed.

2. **Through Penetrants —** One or more nom 2 in. diam (or smaller) rigid steel conduit or electrical metallic tubing (EMT) to be installed within the opening. The annular space between conduits or tubing shall be min 0 in. (point contact) to max 3-3/8 in. The annular space between conduits or tubing and periphery of opening shall be min 0 in. (point contact) to max 3 in. Conduit or tubing to be rigidly supported on both sides of wall assembly.

3. **Fill Void or Cavity Material - Foam* —** Fill material applied within annulus flush with both surfaces of the wall. Min fill material thickness for 1 Hr F Rating is 4-3/4 in. Min fill material thickness for 2 Hr F Rating is 6 in.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — CP 620 Fire Foam

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Last Updated on 2001-12-07

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ONLINE CERTIFICATIONS DIRECTORY

System No. W-L-2078
XHEZ.W-L-2078
Through-penetration Firestop Systems

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XHEZ - Through-penetration Firestop Systems

See General Information for Through-penetration Firestop Systems

System No. W-L-2078

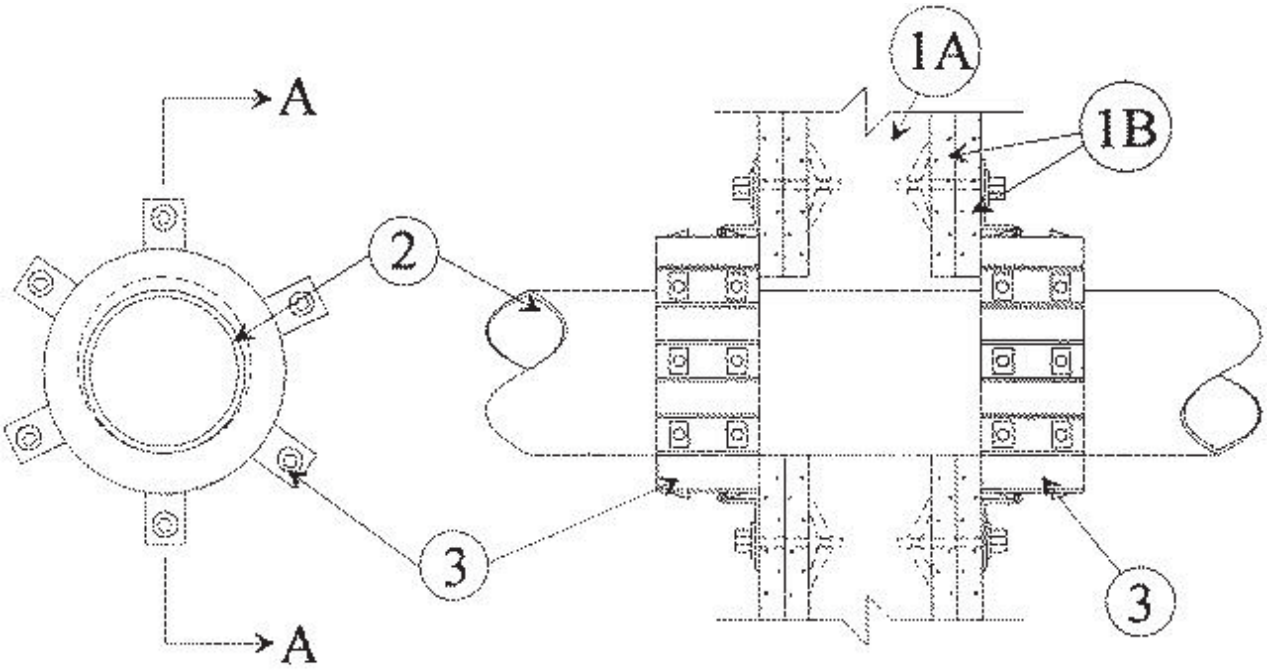
January 28, 2015

F Ratings — 1 and 2 Hr (See Item 1)

T Ratings — 0, 1 and 2 Hr (See Items 2 and 3)

L Rating At Ambient — 3 CFM/sq ft

L Rating At 400 F — Less Than 1 CFM/sq ft



SECTION A-A

1. **Wall Assembly —** The fire-rated gypsum board/stud wall assembly shall be constructed of the materials and in the manner specified in the individual U300, U400, V400 or W400 Series Wall and Partition Designs in the UL fire Resistance

Directory and shall include the construction features noted below:

A. **Studs —** Wall framing may consist of either wood studs or steel channel studs. Wood studs to consist of nom 2 by 4 in. (51 by 102 mm) lumber spaced max 16 in. (406 mm) OC. Steel studs to be min 2-1/2 in. (64 mm) wide and spaced max 24 in. (610 mm) OC.

B. **Gypsum Board* —** Nom 5/8 in. (16 mm) thick gypsum board, as specified in the individual Wall and Partition Design. Max diam of opening is 11-1/2 in. (292 mm).

The hourly F Rating of the firestop system is equal to the hourly fire rating of the wall assembly in which it is installed.

2. **Through-Penetrants —** One nonmetallic pipe, conduit or tubing to be installed within the firestop system. The annular space between pipe and periphery of opening shall be min 0 in. (point contact) to max 1/2 in. (13 mm). Pipe or conduit to be rigidly supported on both sides of the wall assembly. The following types and sizes of nonmetallic pipes may be used:

A. **Polyvinyl Chloride (PVC) Pipe —** Nom 10 in. (254 mm) diam (or smaller) Schedule 40 solid-core or cellular core PVC pipe for use in closed (process or supply) or vented (drain, waste or vent) piping system.

B. **Chlorinated Polyvinyl Chloride (CPVC) Pipe —** Nom 10 in. (254 mm) diam (or smaller) SDR13.5 CPVC pipe for use in closed (process or supply) piping systems.

C. **Acrylonitrile Butadiene Styrene (ABS) Pipe —** Nom 6 in. (152 mm) diam (or smaller) Schedule 40 solid-core or cellular core ABS pipe for use in closed (process or supply) or vented (drain, waste or vent) piping systems

D. **Flame Retardant Polypropylene (FRPP) Pipe —** Nom 6 in. (152 mm) diam (or smaller) Schedule 40 FRPP pipe for use in closed (process or supply) or vented (drain, waste or vent) piping system.

E. **Polyvinylidene Fluoride (PVDF) Pipe —** Nom 4 in. (102 mm) diam (or smaller) PVDF pipe for use in closed (process or supply) or vented (drain, waste or vent) piping system.

When max 6 in. diam pipe is used, T Rating is equal to the hourly fire rating of the wall. When nom 8 in. or 10 in. (203 or 254 mm) diam pipe is used, T Rating is 0 hr.

3. **Firestop Device* — Firestop Collar —** Firestop collar shall be installed in accordance with the accompanying installation instructions. Collar to be installed and latched around the pipe and secured to both sides of the wall using the anchor hooks provided with the collar. (Minimum two anchor hooks for 1-1/2 and 2 in. (38 and 51 mm) diam pipes, three anchor hooks for 3 and 4 in. (76 and 102 mm) diam pipes, four anchor hooks for 6 in. (152 mm) diam pipes, ten anchor hooks for 8 in. (203 mm) diam pipes and twelve anchor hooks for 10 in. (254 mm) diam pipes. The anchor hooks are to be secured to the surface of wall with 3/16 in. (4.8 mm) diam by 2-1/2 in. (64 mm) long steel toggle bolts along with washers. As an alternate for pipe sizes of nom 4 in. diam or less, min No. 10 by 1-1/2 in. (254 by 38 mm) long drywall or laminate screws with min 3/4 in. (19 mm) steel washers may be used. **When the drywall or laminate screw is used, T Rating shall not exceed 1 hr.**

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — CP 643 50/1.5"N, CP 643 63/2"N, CP 643 90/3"N, CP 643 110/4"N, CP 643 160/6"N, CP 644 200/8" andCP 644 250/10" Firestop Collars

4. **Fill, Void or Cavity Material* — Sealant - (Not Shown) —** Min 1/2 in. (13 mm) thickness of sealant applied within the annular space for nom 8 in. and 10 in. (203 and 254 mm) diam pipes, flush with each side of wall. Sealant in annular space is optional for max 6 in. (152 mm) diam pipes. A min 1/4 in. (6 mm) thickness of sealant is required within the annular space, flush with each side of wall, to attain the L Ratings for max 6 in. (152 mm) diam pipes.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — FS-One Sealant or FS-ONE MAX Intumescent Sealant

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ONLINE CERTIFICATIONS DIRECTORY

System No. W-L-3112
XHEZ.W-L-3112
Through-penetration Firestop Systems

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XHEZ - Through-penetration Firestop Systems

XHEZ7 - Through-penetration Firestop Systems Certified for Canada

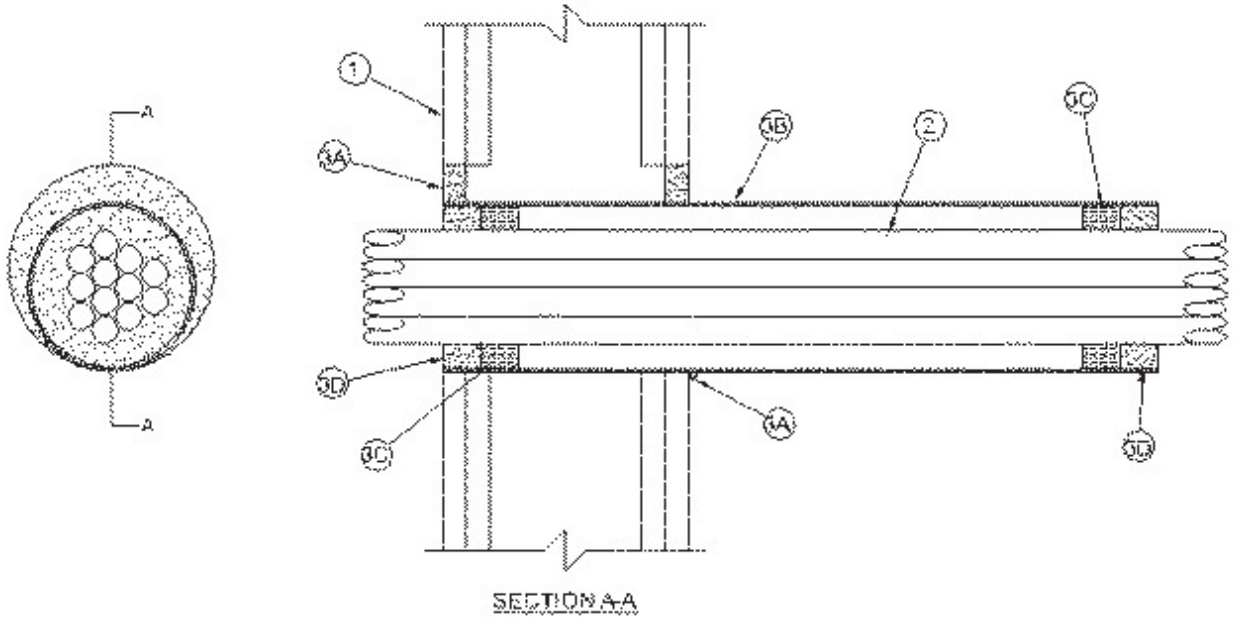
See General Information for Through-penetration Firestop Systems

See General Information for Through-penetration Firestop Systems Certified for Canada

System No. W-L-3112

January 26, 2015

ANSI/UL1479 (ASTM E814)	CAN/ULC S115
F Rating — 1 and 2 Hr (See Item 1)	F Rating — 1 and 2 Hr (See Item 1)
T Rating — 0 Hr	FT Rating — 0 Hr
	FH Rating — 1 and 2 Hr (See Item 1)
	FTH Rating — 0 Hr



SECTION A-A

1. **Wall Assembly —** The 1 or 2 hr fire rated gypsum board/stud wall assembly shall be constructed of the materials

and in the manner specified in the individual U300, U400, V400 or W400 Series Wall and Partition Designs in the UL Fire Resistance Directory and shall include the following construction features:

A. **Studs —** Wall framing may consist of either wood studs or steel channel studs. Wood studs to consist of nom 2 by 4 in. (51 by 102 mm) lumber spaced 16 in. (406 mm) OC. Steel studs to be min 2-1/2 in. (64 mm) wide and spaced max 24 in. (610 mm) OC.

B. **Gypsum Board* —** 5/8 in. (16 mm) thick, 4 ft (122 cm) wide with square or tapered edges. The gypsum board type, thickness, number of layers, fastener type and sheet orientation shall be as specified in the individual Wall and Partition Design in the UL Fire Resistance Directory. Max diam of opening is 5 -1/2 in. (140 mm).

The hourly F, FH rating of the firestop system is equal to the hourly fire rating of the wall assembly in which it is installed.

2. **Cables —** Aggregate cross-sectional area of cables in steel sleeve to be 36 percent of the aggregate cross-sectional area of the sleeve. Cables to be rigidly supported on both sides of wall assembly. Any combination of the following types and sizes of copper conductor cable may be used:

A. Max 300 kcmil single conductor Type MTW, THHN, THWN or AWM power cables; cross-linked polyethylene (XLPE) insulation.

B. Max 4 pair No. 24 AWG telephone cable intended for plenum applications.

C. Max 3/C No. 12 AWG with polyvinyl chloride (PVC) insulation and jacket.

3. **Firestop System —** The firestop system shall consist of the following:

A. **Fill, Void or Cavity Material* — Sealant or Putty —** Min 5/8 in. (16 mm) thickness of fill material applied within the annulus, flush with both sides of wall. At point contact, a min ½ in. (13 mm) bead of fill material shall be applied at sleeve/wall interface when sleeve extends beyond surface of wall.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — FS-ONE Sealant, FS-ONE MAX Intumescent Sealant or CP618 Firestop Putty Stick

B. **Steel Sleeve —** Nom 4 in. (102 mm) diam (or smaller) steel electrical metallic tubing (EMT) or Schedule 5 steel pipe. The annular space between steel sleeve and periphery of opening shall be min 0 in. (point contact) to max 1 in. (25 mm). Sleeve may extend up to 18 in. (457 mm) beyond the wall surfaces. When sleeve extends more than 4 in (102 mm) beyond surface of wall, sleeve to be rigidly supported.

C. **Packing Material —** Min 1 in. (25 mm) thickness of min 4.0 pcf (64 kg/m^3) mineral wool batt insulation firmly packed into each end of sleeve as a permanent form. Packing material to be recessed from each end of sleeve as required to accommodate the required thickness of fill material.

D. **Fill, Void or Cavity Material* — Putty —** Min 1 in. (25 mm) thickness of fill material applied within the sleeve, flush with both ends.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — CP618 Firestop Putty Stick

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ONLINE CERTIFICATIONS DIRECTORY

System No. W-L-4011
XHEZ.W-L-4011
Through-penetration Firestop Systems

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- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.
- Only products which bear UL's Mark are considered Certified.

XHEZ - Through-penetration Firestop Systems

XHEZ7 - Through-penetration Firestop Systems Certified for Canada

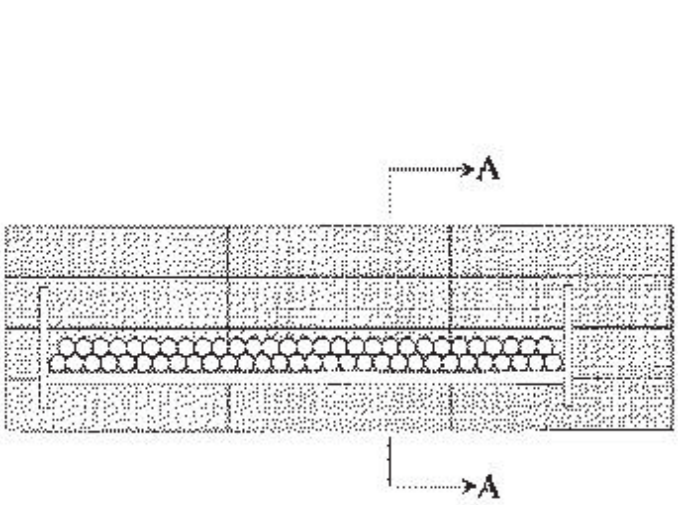
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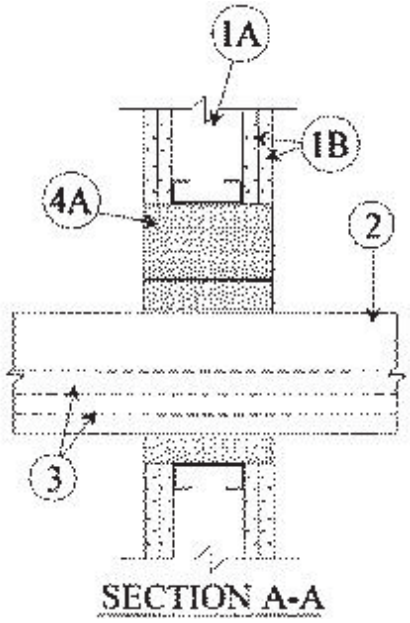
See General Information for Through-penetration Firestop Systems Certified for Canada

System No. W-L-4011

January 23, 2015

ANSI/UL1479 (ASTM E814)	CAN/ULC S115
F Ratings — 1 and 2 Hr (See Item 1)	F Ratings — 1 and 2 Hr (See Item 1)
T Rating — 0 Hr	FT Rating — 0 Hr
L Rating At Ambient — 5 CFM/sq ft	FH Ratings — 1 and 2 Hr (See Item 1)
L Rating At 400 F — 2 CFM/sq ft	FTH Rating — 0 Hr
	L Rating At Ambient — 5 CFM/sq ft
	L Rating At 400 F — 2 CFM/sq ft





SECTION A-A

1. **Wall Assembly —** The 1 or 2 hr fire rated gypsum board/stud wall assembly shall be constructed of the materials and in the manner described in the individual U300, U400, V400 or W400 Series Wall and Partition Designs in the UL Fire Resistance Directory and shall include the following construction features:

A. **Studs —** Wall framing may consist of either wood studs or steel channel studs. Wood studs to consist of nom 2 in. (51 mm) by 4 in. (102 mm) lumber spaced 16 in. (406 mm) OC. Steel studs to be min 2-1/2 in. (64 mm) wide and spaced max 24 in. (610 mm) OC. Additional framing member shall be installed in stud cavity containing through-penetrating item to form a rectangular box around penetrant.

B. **Gypsum Board* —** 5/8 in. (16 mm) thick, 4 ft (1219 cm) wide with square or tapered edges. The gypsum board type, thickness, number of layers, fastener type and sheet orientation shall be as specified in the individual Wall and Partition Design in the UL Fire Resistance Directory. Max size of opening 9 in. (229 mm) by 30 in. (762 mm).

The hourly F and FH Ratings of the firestop system are equal to the hourly fire rating of the wall assembly in which it is installed.

Min finished wall thickness is 5 in. (127 mm).

2. **Cable Tray* —** Max 24 in. (610 mm) wide by max 6 in. (152 mm) deep open-ladder or solid-back cable tray with channel-shaped side rails formed of 0.10 in. (2.54 mm) thick aluminum or 0.060 in. (1.54 mm) thick steel and with 1-1/2 in. (38 mm) wide by 1 in. (25 mm) channel shape rungs spaced 9 in. (229 mm) OC or a 0.029 in. (0.74 mm) thick steel solid back, respectively. The annular space between the cable tray and the periphery of the opening shall be min 0 in. (point contact) to max 4 in. (102 mm). Cable tray to be rigidly supported on both sides of floor or wall assembly.

3. **Cables —** Aggregate cross-sectional area of cables in cable tray to be max 45 percent of the cross-sectional area of the cable tray based on a max 5 in. (127 mm) cable loading depth. Any combination of the following types and sizes of copper conductor cables may be used:

A. 1/C, 750 kcmil (or smaller) power cable with EPR insulation and PVC jacket.

B. 300 pair — No. 24 AWG cable with PVC insulation and jacket

C. Twenty-four fiberoptic cable with PVC subunit and jacket.

D. Max three 1/C, No. 12 AWG wire, insulated with polyvinyl chloride, in a nom 3/4 in. (19 mm) **Flexible Metal Conduit+.**

4. **Firestop System —** The firestop system shall consist of the following:

A. **Fill, Void or Cavity Material* - Fire Blocks —** For walls incorporating max 3-5/8 in. (92 mm) steel studs or max 2 in. (51 mm) by 4 in. (102 mm) wood studs, fire block installed with 5 in. (127 mm) dimension projecting through and centered in opening. For walls constructed of larger steel or wood studs, fire block installed with long dimension passing through and centered in opening. Blocks may or may not be cut flush with both surfaces of wall. When multiple layers of gypsum board are used, blocks may be recessed 1/2 in. (13 mm) from surface of wall. Blocks firmly packed within opening. Either one or a combination of the block types specified below may be used.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — FS-657 Fire Block or CFS-BL Firestop Block

B. **Fill, Void or Cavity Material* - Sealant or Putty (Not shown) —** Fill material to be forced into interstices of cables and between cables and cable trays to max extent possible on both surfaces of the penetration.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — FS-ONE Sealant, FS-ONE MAX Intumescent Sealant or CP618 Firestop Putty Stick (Note: L Ratings apply only when FS-One Sealant is used)

+Bearing the UL Listing Mark

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**

Last Updated on 2015-01-23

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ONLINE CERTIFICATIONS DIRECTORY

System No. W-L-5025
XHEZ.W-L-5025
Through-penetration Firestop Systems

Page Bottom

Design/System/Construction/Assembly Usage Disclaimer

- Authorities Having Jurisdiction should be consulted in all cases as to the particular requirements covering the installation and use of UL Certified products, equipment, system, devices, and materials.
- Authorities Having Jurisdiction should be consulted before construction.
- Fire resistance assemblies and products are developed by the design submitter and have been investigated by UL for compliance with applicable requirements. The published information cannot always address every construction nuance encountered in the field.
- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.
- Only products which bear UL's Mark are considered Certified.

XHEZ - Through-penetration Firestop Systems

XHEZ7 - Through-penetration Firestop Systems Certified for Canada

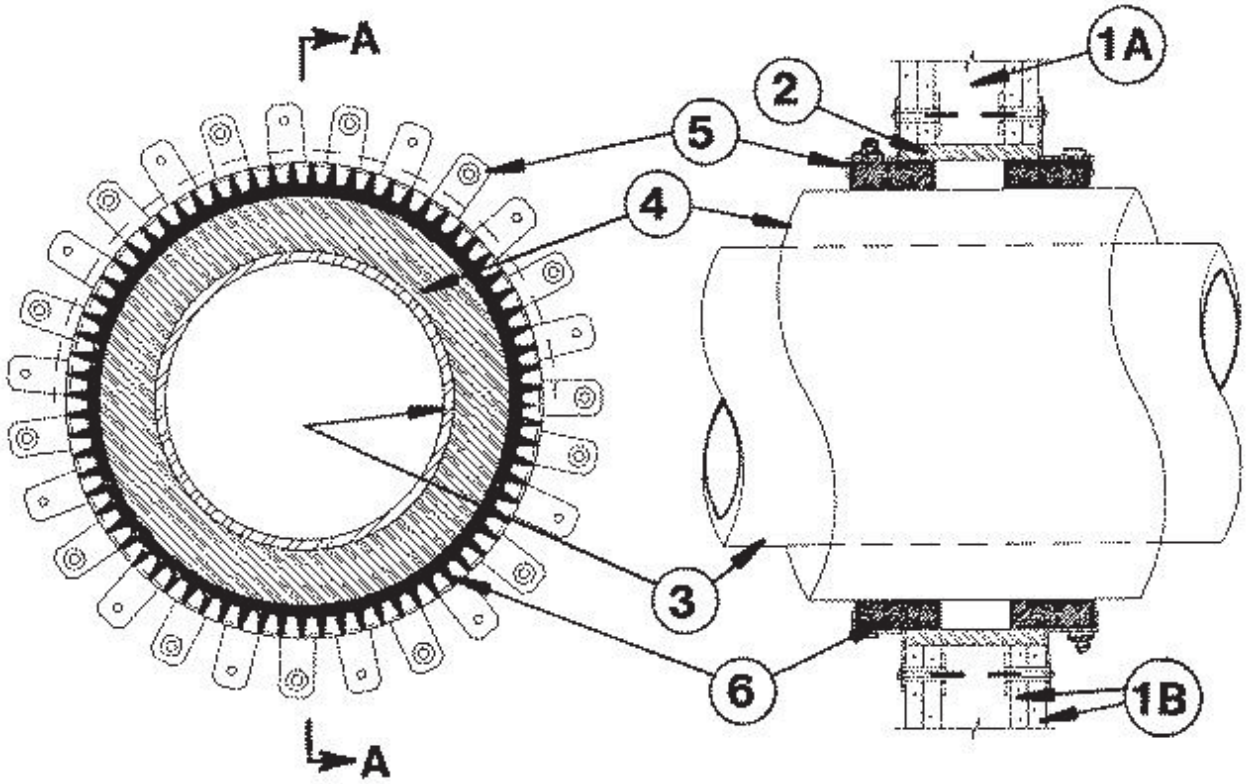
See General Information for Through-penetration Firestop Systems

See General Information for Through-penetration Firestop Systems Certified for Canada

System No. W-L-5025

January 27, 2015

ANSI/UL1479 (ASTM E814)	CAN/ULC S115
F Rating — 1 and 2 Hr (See Items 1 and 6)	F Rating — 1 and 2 Hr (See Items 1 and 6)
T Rating — 0 and 3/4 Hr (See Item 1)	FT Rating — 0 and 3/4 Hr (See Item 1)
L Rating At Ambient — 4 CFM/sq ft	FH Rating — 1 and 2 Hr (See Items 1 and 6)
L Rating At 400 F — Less Than 1 CFM/sq ft	FTH Rating — 0 and 3/4 Hr (See Item 1)
W Rating — Class 1 (See Item 2B)	L Rating At Ambient — 4 CFM/sq ft
	L Rating At 400 F — Less Than 1 CFM/sq ft



SECTION A-A

1. **Wall Assembly —** The 1 or 2 hr fire-rated gypsum wallboard/stud wall assembly shall be constructed of the materials and in the manner specified in the individual U300, U400, V400 or W400 Series Wall and Partition Designs in the UL Fire Resistance Directory and shall include the following construction features:

A. **Studs —** Wall framing may consist of either wood studs or steel channel studs. Wood studs to consist of nom 2 by 4 in. (51 by 102 mm) lumber spaced 16 in.(406 mm) OC. Steel studs to be min 2-1/2 in. (64 mm) wide and spaced max 24 in. (610 mm) OC.

B. **Gypsum Board* —** 5/8 in. (16 mm) thick, 4 ft (122 cm) wide with square or tapered edges. The gypsum wallboard type, number of layers, fastener type and sheet orientation shall be as specified in the individual Wall and Partition Design. Max diam of opening is 14-1/2 in. (368 mm) for wood stud walls and 18 in. (457 mm) for steel stud walls.

The hourly F, FH Ratings of the firestop system are equal to the hourly fire rating of the wall assembly in which it is installed. The T, FT, FTH Ratings are 0 and 3/4 hr when installed in 1 and 2 hr rated walls, respectivley.

2. **Metallic Sleeve —** (Optional) — Nom 18 in. (457 mm) diam (or smaller) Schedule 40 (or thinner) steel pipe cast into wall assembly with joint compound and installed flush with wall surfaces.

3. **Through-Penetrants —** One metallic pipe or tubing to be centered within the firestop system. Pipe or tubing to be rigidly supported on both sides of wall assembly. The following types and sizes of metallic pipes or tubing may be used:

A. **Steel Pipe —** Nom 10 in. (254 mm) diam (or smaller) Schedule 10 (or heavier) steel pipe.

B. **Copper Tubing —** Nom 4 in. (102 mm) diam (or smaller) Type L (or heavier) copper tubing.

C. **Copper Pipe —** Nom 4 in. (102 mm) diam (or smaller) Regular (or heavier) copper pipe.

4. **Pipe Covering* —** Nom 2 in. (51 mm) thick hollow cylindrical heavy density (min 3.5 pcf or 56 kg/m^3) glass fiber units jacketed on the outside with an all service jacket. Longitudinal joints sealed with metal fasteners or factory-applied self-sealing lap tape. Transverse joints secured with metal fasteners or with butt tape supplied with the product. A nom annular space of 1-1/8 in.(29 mm) is required within the firestop system.

See **Pipe and Equipment Covering — Materials** (BRGU) category in the Building Material Directory for the names of manufacturers. Any pipe covering material meeting the above specifications and bearing the UL Classification Marking with a Flame Spread Index of 25 or less and a Smoke Developed Index of 50 or less may be used.

5. **Steel Collar —** Collar fabricated from precut 0.017 in. (0.43 mm) thick (28 MSG) galv sheet steel available from the sealant manufacturer. Collar shall be nom 2 in. (51 mm) deep with min 1-1/4 in. (32 mm) wide by 2 in. (51 mm) long anchor tabs for securement to wall surface. Retainer tabs, 1/4 in. (6 mm) wide by 3/4 in. (19 mm) long and located opposite the anchor tabs are folded 90 degrees toward pipe surface to maintain the annular space around the pipe and to retain the fill material. Collar secured to surface of wall with 1/4 in. (6 mm) toggle bolts. A nom 1/2 in. (13 mm) wide stainless steel hose clamp was secured to each of the collars at mid-depth.

6. **Fill, Void or Cavity Material* — Sealant —** In 1 hr fire rated assemblies, min 5/8 in. (16 mm) thickness of fill material applied within the annulus. In 2 hr fire rated assemblies, min 1-1/4 in. (32 mm) thickness of fill material applied within the annulus. Additional fill material applied to completely fill the collars.

HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC — FS-One Sealant or FS-ONE MAX Intumescent Sealant

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**

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SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes sealants for the following applications, including those specified by reference to this Section:

1. Exterior joints in the following vertical surfaces and nontraffic horizontal surfaces:

    a. Perimeter joints between materials listed above and frames of doors and windows.

2. Exterior joints in the following horizontal traffic surfaces:

    a. Control, expansion, and isolation joints in cast-in-place concrete slabs.

3. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:

    a. Vertical control joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
    b. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
    c. Joints between plumbing fixtures and adjoining walls, floors, and counters.
    d. Other joints as indicated.

1.3 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

1.4 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials in compliance with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer.

B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products indicated for each type in the sealant schedules at the end of Part 3.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range for this characteristic.

2.3 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealant Standard: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant in the Elastomeric Joint-Sealant Schedule at the end of Part 3, including those referencing ASTM C 920 classifications for type, grade, class, and uses.

2.4 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant for Exposed and Concealed Joints: For each product of this description indicated in the Acoustical Joint-Sealant Schedule at the end of Part 3, provide manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following:

1. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

2.5 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

2.6 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants with joint substrates.

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions and the following requirements:
   1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
   2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming

or blowing out joints with oil-free compressed air. Porous joint surfaces include the following:

a. Concrete.
b. Masonry.
c. Unglazed surfaces of ceramic tile.

3. Remove laitance and form-release agents from concrete.

B. Joint Priming: Prime joint substrates where recommended in writing by joint sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Acoustical Sealant Application Standard: Comply with recommendations of ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

D. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and back of joints.

F. Install sealants by proven techniques to comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses provided for each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealants from surfaces adjacent to joint.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

3.4 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

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

3.6 ELASTOMERIC JOINT-SEALANT SCHEDULE

A. Multicomponent Nonsag Polysulfide Sealant: Where joint sealants of this type are indicated, provide products complying with the following:

1. Products: Provide one of the following:

    a. cm-60; W.R Meadows, Inc.
    b. T-2235-M; Morton International, Inc.
    c. T-2282; Morton International, Inc.
    d. Thiokol 2P; Morton International, Inc.
    e. GC-5 Synthacalk; Pecora Corporation.
    f. Two-Part Sealant; Sonneborn Building Products Div., ChemRex Inc.

2. Type and Grade: M (multicomponent) and NS (nonsag).
3. Class: 25.
4. Uses Related to Exposure: T (traffic)

3.7 LATEX JOINT-SEALANT SCHEDULE

A. Latex Sealant: Where joint sealants of this type are indicated, provide products complying with the following:

1. Products: Provide one of the following:

    a. Chem-Calk 600; Bostik Inc.
    b. NuFlex 330; NUCO Industries, Inc.
    c. LC 160 All Purpose Acrylic Caulk; Ohio Sealants, Inc.
    d. AC-20; Pecora Corporation.
    e. PSI-701; Polymeric Systems, Inc.
    f. Sonolac; Sonneborn Building Products Div., ChemRex, Inc.
    g. Tremflex 834; Tremco.

3.8 ACOUSTICAL JOINT-SEALANT SCHEDULE

A. Acoustical Sealant for Exposed and Concealed Joints: At all sound partitions and where joint sealants of this type are indicated, provide products complying with the following:

1. Products: Provide one of the following:

a. AC-20 FTR Acoustical and Insulation Sealant; Pecora Corporation.
b. SHEETROCK Acoustical Sealant; USG Corp., United States Gypsum Co.

B. Acoustical Sealant for Concealed Joints: At all sound partitions and where joint sealants of this type are indicated, provide products complying with the following:

1. Products: Provide one of the following:

a. Pro-Series SC-170 Rubber Base Sound Sealant; Ohio Sealants, Inc.
b. BA-98; Pecora Corporation.
c. Tremco Acoustical Sealant; Tremco.

END OF SECTION

SECTION 081113 – HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included: Provide and install hollow metal doors and frames, complete, as shown on Drawings and as specified.

1. Hollow Metal Door and Frame Sets.

2. Hollow Metal Interior Window Frames.

3. Hollow Metal Frames for Wood Doors specified in Section 081416 – Flush Wood Doors.

4. Coordinate Door and Frame fabrication with door hardware specified in Section 087100 – Door Hardware as required for the hardware types scheduled on Drawings.

5. Coordinate Door and Frame fabrication with Security and Access Control products specified in DIVISION 26 – Electrical as required for Security and Fire Alarm wiring and interface.

B. Work Specified Elsewhere:

1. Section 050500 – Metal Fasteners.

2. Section 081416– Flush Wood Doors.

3. Section 084113– Aluminum Entrances and Storefronts.

4. Section 084213– Aluminum Framed Entrance

5. Section 087100 – Door Hardware.

7. Section 088000 –Glazing.

8. Section 085113 – Aluminum Windows.

1.2 REFERENCE STANDARDS

A. Hollow Metal Manufacturers Association (HMMA) Division of National Association of Architectural Metal Manufacturers (NAAMM):

1. Hollow Metal Manual; including HMMA 800, 801, 802, 810, 820, 830, 840, 841, 850, 860, 861, 862, 863, 880, 881, and 882.

1.3 QUALITY ASSURANCE

A. Comply with the latest edition of the following Standards:

1. National Fire Protection Association (NFPA):

a. NFPA No. 80: "Fire Doors and Windows".

b. NFPA No. 251: "Fire Tests of Building Construction and Materials".

c. NFPA No. 252: "Fire Tests of Door Assemblies".

d. NFPA No. 257: "Fire Tests of Window Assemblies".

2. American Society for Testing and Materials (ASTM):

a. ASTM E-119: "Methods for Fire Tests of Building Construction and Materials".

b. ASTM E-152: "Standard Methods of Fire Tests of Door Assemblies."

c. ASTM E-163: "Methods for Fire Tests of Window Assemblies".

3. American National Standards Institute (ANSI):

a. A250.8: "Recommended Specifications for Standard Steel Doors and Frames".

4. Underwriters' Laboratories' (UL):

a. UL-9: "Fire Tests of Door Assemblies".

b. UL-10C: "Fire Tests of Window Assemblies".

B. Testing Agency Qualifications: Testing agency testing all fire rated doors and frames, shall have approval of enforcing authority for this project and provide inspection of materials and workmanship at factory during fabrication and assembly.

C. Requirements of Regulatory Agencies: Where opening has fire resistive rating of 20 minutes or longer, door shall bear testing agency-issued label.

a. Provide "T" temperature rating labels.

1.4 SUBMITTALS

A. Comply with provisions of Section 013300 – Submittal Procedures.

B. Product Data: Manufacturer's specifications, catalog cuts, data, and installation instructions.

C. Shop Drawings:

1. General: Show frame type, material descriptions and gauges, exact profiles, elevations, fire-resistive rating and complete details, including reinforcing, anchors, and connections.

a. Identify non-conforming frames and assemblies that cannot be fire rated or labeled for Architect's review and direction.

2. Provide Elevation Drawings for each frame assembly, fully dimensioned and identified by numbering nomenclature used on Drawings, including:

   a. Locations of rough-in and reinforcing preparation for hardware provided in other Sections.

   b. Routing of electrical conduit or cable within frame members.

   c. Glass Type for each Lite, incorporating nomenclature used on Drawings.

   d. Locations of Doors, including swing and Door numbering nomenclature used on Drawings.

   e. Frame Finish.

3. Provide full-size special details showing thickness, profiles, jointing, connections, and assembly of various members, reinforcement, anchorage, and supports.

D. Samples: Submit 12-inch by 12-inch "L" section of metal door frame showing corner detail, anchor, weld, and finish.

E. Certificates: Submit certificates for specified doors and frames indicating compliance with fabrication and minimum labeling requirements. Certificates signed by Contractor and authorized representative of hollow metal manufacturing company.

1.6 PRODUCT HANDLING

A. General: Deliver, store, and handle hollow metal work in manner to prevent damage, distortion, and deterioration.

B. Packaging: Package hollow metal work in cardboard or other containers with separators, banding, spreaders, and paper wrappings to protect items during transit and Project site storage.

C. Manufacturer's Recommendations: Follow special storage and handling requirements of manufacturer.

D. Identification: Mark each door and door frame, on a surface which will be hidden after installation, with designation of opening for which it is furnished. Mark opening designation also on exterior packaging for each door and door frame.

1.7 COORDINATION

A. Hardware Suppliers: Furnish hollow metal frame manufacturer with accepted hardware schedule, hardware templates, and samples of physical hardware where necessary to ensure correct fitting and installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. General: Provide products manufactured by Stiles Custom Metal, Inc; Curries Company, an ASSA ABLOY Group Company; Steelcraft, an Ingersoll Rand Company OR Ceco, an ASSA ABLOY Group Company

2.2 MATERIALS – GENERAL

A. Steel Sheet:

1. General: Free of scale, pitting, and surface defects.

2. Cold-Rolled: ASTM A366, commercial grade.

3. Hot-Rolled: ASTM A569, commercial grade, pickled.

4. Galvanized: Cold-rolled or hot-rolled sheet with zinc coating applied by hot-dip process per ASTM A526 (A60 or G60) with coating weight of not less than 0.30 ounces per square foot per side.

2.3 HOLLOW METAL DOORS

A. Faces:

1. Interior Doors: Cold-rolled or hot-rolled steel sheet; not less than 18 gauge.

2. Exterior Doors: Galvanized steel sheet, not less than 16 gauge.

B. Door Thickness: 1-3/4-inches, unless otherwise shown.

C. Door Types: Flush. Fully-welded seamless construction with no visible seams or joints on faces or vertical edges.

D. Door Construction:

1. General: Fabricate doors in conformance with ANSI A250.8, including:

a. Level and Physical Performance Level: Level 3 and Extra heavy Duty per ANSI A250.8.

b. Model: 2 (Seamless per ANSI A250.8).

2. Reinforcement: Stiffen face sheets by continuous vertical formed steel stiffener sections spanning full thickness of interior space between door faces.
3. Stiffeners: Not less than 22 gauge space not more than 6-inches apart and securely attach to face sheets by spot welds not more than 5-inches on center. Fill spaces between stiffeners to sound-deaden and insulate full height of door with an inorganic non-combustible batt-type material.

4. Door Faces: Join at vertical edges by continuous weld extending full height of door. Grind, fill, and dress welds smooth to make invisible and provide smooth flush surface.

5. Top and Bottom Edges: Close with continuous recessed steel channel not less than 16 gauge, extending full width of door and spot welded to both faces. At exterior doors provide an additional flush closing channel at top edges and, where required for attachment of weather-stripping, a flush closure also at bottom edges. Provide openings in bottom closure of exterior doors to permit escape of entrapped moisture.

6. Edge Profiles: Provide for both vertical edges of doors as follows:

   a. Single-Acting Swing Doors: Bevel 1/8-inch in 2 inches.

   b. Double-Acting Swing Doors: Round on 2-1/8-inch radius.

7. Hardware Reinforcements:

   a. General: Mortise, reinforce, drill and tap doors at factory for fully-templated hardware only, per hardware schedule and templates provided by hardware suppliers specified in Section 08710 – Door Hardware, and DIVISION 16 –Electrical (Fire Alarm and Security Requirements). Where surface-mounted hardware is scheduled, provide reinforcing plates only; drilling and tapping done by others.

   b. Minimum Gauges For Hardware Reinforcing Plates: As follows:

      1) Hinge and Pivot Reinforcements: 7 gauge.

      2) Reinforcements for Lock Face, Flush Bolts, Concealed Holders: 12 gauge.

      3) Reinforcements for All Other Surface-Mounted Hardware: 16 gauge.

8. Astragals:

   a. Dutch Bend Astragal: Provide as integral part of door unless otherwise shown or scheduled. Fabricate astragal of three thickness of metal of same gauge as face sheet. Fabricate reveal on opposite door leaf from top to bottom for dutch bend astragal to lay flush with face.

   b. Location:

      1) Exterior Pairs of Doors:

         a) Outswing: Astragal on exterior side of active door leaf.

         b) Inswinging: Astragal on exterior side of inactive leaf.

9. Louvers: Welded blade type of construction. Louvers pierced into face sheets not permitted.

10. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.

E. Electrical Requirements:

1. General: Make provisions for installation of electrical items specified under Section 087100 – Door Hardware, and DIVISION 16 –Electrical (Fire Alarm and Security Requirements) and other applicable Sections; arrange in manner so wiring can be readily removed and replaced.

2. Doors with Electric Hardware:

a. General: Provide with metal raceway or conduit to permit wiring from electric hinge to other electric door hardware.

b. Hinges or Pivot Location: Center or intermediate as applicable; top or bottom not permitted.

c. Install Electro Lynx wiring and Molex type connectors. Furnished by Section 087100, Door Hardware.

2.4 HOLLOW METAL PANELS

A. General: Fabricate and finish hollow metal panels as specified for hollow metal doors.

2.5 HOLLOW METAL FRAMES

A. Materials:

1. Interior Frames: Cold-rolled or hot-rolled steel sheet; not less than 16 gauge for openings 48-inches and less in width, and not less than 14 gauge for openings greater than 48-inches in width.

2. Exterior Frames: Galvanized steel sheet; not less than 14 gauge.

B. Fabrication:

1. General: Provide welded units with integral trim, of sizes and shapes shown. Knocked-down frames acceptable at interior non-rated openings only.

2. Finished Work: Strong and rigid, neat in appearance, square, true and free of defects, warp or buckle. Fabricate molded members clean cut, straight and of uniform profile throughout their lengths.

3. Jamb Depths, Trim, Profile, Returns, and Backbends: As shown.

4. Corner Joints: Close contact edges tight, miter and continuously weld trim edges, and miter (butt) stops. Use of gussets not permitted.

5. Stops: Minimum depth 5/8-inches.

6. Large Openings: When shipping limitations so dictate, fabricate frames for large openings in sections designed for splicing in field.

7. Multiple or Special Openings: Fabricate frames for multiple or special openings with mullion and/or rail members which are closed tubular shapes having no visible seams or joints. Securely weld joints between faces of abutting members and finish smooth.

8. Hardware Reinforcements:

   a. General: Mortise, reinforce, drill, and tap frames at factory for fully templated mortised hardware only, per hardware schedule and templates provided by hardware supplier. Where surface-mounted hardware is to be applied, provide frames with reinforcing plates only.

   b. Hardware Reinforcing Plates: Minimum thickness as follows:

      1) Hinge And Pivot Reinforcements: 7 gauge, 1-1/4-foot by 10-inches, minimum size.

      2) Strike Reinforcements: 12 gauge.

      3) Flush Bolt Reinforcements: 12 gauge.

      4) Closer Reinforcements: 12 gauge.

      5) Surface-Mounted Hardware Reinforcements: 12 gauge.

      6) Hold-Open Arm Reinforcements: 12 gauge.

      7) Surface Exit Device Reinforcements: 12 gauge.

9. Jamb Anchors:

   a. Masonry Walls: Provide frames with adjustable jamb anchors. Anchors not less than 16-gauge steel or 0.156-inch diameter steel wire. Stirrup straps shall be not less than 2 inches by 10 inches in size, corrugated and/or perforated. Provide anchors on each jamb as follows:

      Frames up to 7'-6" height: 3 anchors.
      Frames 7'-6" to 8'-0" height: 4 anchors.
      Frames over 8'-0" height: 1 anchor for each 2' or fraction thereof in height.

   b. Stud Partitions: Provide frames with steel anchors of suitable design, not less than 18-gauge thickness, securely welded inside each jamb as follows:

      Frames up to 7'-6" height: 4 anchors.
      Frames 7'-6" to 8'-0" height: 5 anchors.
      Frames over 8'-0" height: 5 anchors plus one additional for each 2' or fraction thereof over 8'-0".

c. Previously Placed Concrete or Masonry: Provide frames to be anchored to previously placed concrete, masonry or structural steel with anchors of suitable design as shown on approved shop drawings.

10. Floor Anchors:

a. General: Securely weld inside each jamb, with two holes provided at each jamb for floor anchorage.

b. Adjustable Anchors: Where so scheduled or specified, provide adjustable floor anchors, not less than 2 inches in height adjustment.

c. Thickness: Minimum 14 gauge.

11. Masonry Wall Openings More Than 48-Inches In Width: Provide with angle or channel stiffener factory welded into head; stiffeners not less than opening width and not used as lintels or load-bearing members.

12. Dust Cover Boxes: Or mortar guards, provide of not thinner than 26-gauge steel at hardware mortises on frames to be set in masonry or plaster partitions.

13. Steel Spreader: Provide frames with steel spreader temporarily attached to feet of both jambs to serve as brace during shipping and handling. Steel spreader not to be used for installation purposes.

C. Electrical Requirements:

1. General: Make provisions for installation of electrical items specified under Section 087100 – Door Hardware, and DIVISION 26 –Electrical (Fire Alarm and Security Requirements) and other applicable Sections; arrange in manner so wiring can be readily removed and replaced.

2. Frames with Electric Hinges:

a. General: Dust cover boxes or mortar guard for electrical hinges furnished under Section 087100 – Door Hardware; weld into place under this Section.

b. Hinge or Pivot Location: Center or intermediate as applicable; top or bottom not permitted.

3. Back Box for Electrical Hardware Items: Furnished under Section 087100 – Door Hardware; weld into place under this Section.

2.6 FIRE-RATED DOORS AND FRAMES

A. General: Provide labeled doors and frames for those openings requiring fire protection ratings as scheduled. Construct such doors and frames as tested and approved by UL, WHI, or other nationally recognized testing agency having factory inspection service.

B. Non-Ratable Openings: Identify on Shop Drawings any door or frame scheduled to be fire-rated cannot qualify for appropriate labeling because of its design, hardware or any other reason. Do not begin fabrication for non-ratable items until all issues have been resolved.

2.7 STOPS AND MOLDINGS

A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, fabricated from same material as door face sheet in which they are installed.

B. Fixed Frame Moldings: Formed integral with standard steel frames, minimum 5/8 inch high, unless otherwise indicated.

C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, fabricated from same material as frames in which they are installed.

2.8 SHOP PAINTING

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish standard steel door and frames after assembly.

B. Galvanized Steel Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.

1. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

C. Steel Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning"; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel; comply with SSPC-SP 3, "Power Tool Cleaning," or SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

D. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 0.7-mils.

E. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied finish paint system indicated; and providing a sound foundation for field-applied topcoats despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine substrate and conditions under which hollow metal doors and frames are to be installed and give notification, in writing, of any conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF FRAMES

A. General: Install frames per Reference Standards and as specified.

B. Labeled Doors and Frames: Install per requirements of labeling authority.

C. Setting: Exercise care in setting of frames to maintain scheduled dimensions, hold head level, and maintain jambs plumb and square.

D. Anchorages and Connections: Secure to adjacent construction. Furnish anchors to suit wall conditions and floor angles or clips welded to frame for fastening to floor.

E. Spreader Bars: Whenever possible, leave frame spreader bars intact until frames are set perfectly square and plumb and anchors are securely attached. Do not use shipping bars as spreaders.

F. Expansion Movement: Allow for as required.

G. Fire-Rated Frames: Install per NFPA Standard No. 80.

H. Exterior Doors: Provide sheet metal drip at head.

I. Frames in Metal Stud Partitions: Frames filled tight with mineral fiber safing as specified in Section 078413 – Penetration Firestopping.

3.3 SHOP COAT TOUCH-UP

A. General: Immediately after installation remove rust, sand smooth, and touch-up items with prime coat which has been damaged with same primer as applied in shop.

3.4 ADJUSTMENT

A. General: Replace or re-hang doors which are hinge-bound or do not swing or operate freely.

3.5 PROTECTION

A. General: Protect installed work against damage from other construction work.

3.6 INSTALLATION OF DOORS

A. General: Install doors per manufacturer's instructions.

B. Hardware: Install per requirements specified in Section 087100 – Door Hardware.

C. Adjustment: Adjust and lubricate operable parts as required for correct function.

END OF SECTION

SECTION 081416- FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included: Provide and install flush wood doors, complete, as shown on Drawings and as specified, including:

1. Flush Wood Doors, including: Wood Veneer Flush Doors, including specified veneer and transparent finish.

2. Provide rated and un-rated doors as scheduled on Drawings.

3. Coordinate Door fabrication with Section 087100 – Door Hardware as required for the hardware types scheduled on Drawings.

4. Coordinate Door fabrication with DIVISION 26 – Electrical as required for Security and Fire Alarm wiring and interface.

B. Work Specified Elsewhere:

1. Section 081113– Hollow Metal Doors and Frames.

2. Section 084113–Aluminum Entrances and Storefronts.

3. Section 087100 – Door Hardware.

4. Section 088000 – Glazing.

1.2 REFERENCE STANDARDS

A. National Wood Window and Door Association (NWWDA):

1. IS 1.1; General Requirements for Flush Wood Doors.

2. IS 1.2; Solid Core Wood Flush Doors.

3. IS 1.4; Special Construction Wood Flush Doors.

4. IS 1.6; Testing and Inspection Requirements for Wood Flush Doors.

B. Standards of Woodwork Institute (WI) "Manual of Millwork."

C. American Society for Testing Materials (ASTM):

1. E-90-02: "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements".

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer: Certified and licensed per NWWDA IS 1 Series.

2. United States Product Standard (PS) "Construction and Industrial Plywood" (PS 1-74).

1.4 SUBMITTALS

A. Comply with provisions of Section 013300 – Submittal Procedures.
B. Product Data: Manufacturer's specifications, catalog cuts, standard details, and installation details.

C. Shop Drawings: Complete, with door schedule; show location, types, sizes, thickness, cutout details, special details and other requirements to assure proper installation.

D. Samples:

1. Doors: Each type showing construction, faces, edges, and specified finishes; 12-inch by 12-inch corner section.

E. Certificates:

1. General: Certification that doors conform to NWMA IS 1 Series.

2. Sound Retardant Doors: Certification that doors comply with specified STC rating.

1.5 EXTENDED WARRANTY

A. Comply with requirements of Section 017600 – Guarantees and Warranties.

B. General: Manufacturer's standard based on NWMA IS 1.1 tolerances and book sizes.

C. Solid Core Doors:

1. Interior: Life of original installation.

1.6 PRODUCT HANDLING

A. Delivery: Package doors per manufacturer's recommendation prior to shipment. Mark and identify doors for each opening to facilitate proper location.

B. Storage: Store doors flat on level surfaces in clean, dry, and properly ventilated spaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Typical Flush Wood Doors: Provide wood doors manufactured by Marshfield Door Systems, VT Industries, Eggers Industries, OR Oshkosh Architectural Wood Doors

2.2 WOOD VENEER FACES FOR TRANSPARENT FINISH

A. General:

1. Provide wood veneer faced flush wood doors as required to match the Architect's samples and in conformance with ANSI/HPVA HP-1; not less than 1/50-inch-thick before finish sanding.

a. Grade: Premium, with Grade A faces.

B.

1. Species: **To match adjacent existing doors**

2. Cut: **To match adjacent existing doors**

3. Veneer Match: **Book Match**

4. Veneer Face Assembly: **Running Match**

3. Application:

a. Face Panel Grade: HPVA Grade AA.

b. Finish: **Species, Cut, and Finish to match adjacent existing doors on this floor. Cut sample of existing door and match species, stain, and cut. Provide sample to architect for approval.**

4. Match between veneer leaves: **Book Match**

5. Fabrication: As specified in this Section.

2.3 MDO FACES FOR SHOP AND FIELD PAINTING

A. Paint-Grade Medium Density Overlay (MDO): Conform to PS 1-74.

B. Paint doors as specified in Section 099123 – Interior Painting.

2.4 FABRICATION – NON-RATED DOORS AND 20-MINUTE RATED DOORS

A. Fabrication:

1. General: Per NWWDA IS 1 Series, Premium Grade; no finger jointing permitted.

B. Cores:

1. Particleboard: Mat-formed wood particle board per ANSI 208.1, Grade 1-L-2 28–32 pounds per cubic foot.
   a. Use particleboard made with binder containing no urea-formaldehyde resin.

2. Blocking: Provide mill option wood blocking in particleboard-core doors as required to eliminate through-bolting hardware for all surface applied hardware.

3. Adhesive: Type I bond.

4. Bonding: Fabricate doors using bonded core construction, including stile and rails bonded to core, using adhesive and pressure during the curing process. Plane assembled and cured door core units to a uniform thickness prior to application of crossbanding and veneers.

5. Crossbands: Dried to 6-9 percent moisture content, minimum 1/16-inch-thick spliced hardwood with no voids or defects, extending full width of doors with grain at right angles to face veneer.

6. Stiles: Provide SCL stiles, minimum 1-3/8-inch-thick before fitting; 1-1/8-inch minimum after trimming. For wood veneer doors, provide outer band matching specified wood veneer, with no exposed crossbands.

7. Rails: Provide wood rails, 1-1/8-inch minimum after trimming; mill option hardwood or softwood of a density equal to or exceeding Douglas Fir.

8. 20 minute particle core shall meet positive pressure and "S" label without use of intumescent seals.

C. Identification: Stamp each door with NWWDA Certification Hallmark.

1. 20-Minute Fire Rated Doors: Provide each door with UL or WHI metal or mylar type labels.

2.6 FABRICATION – 45, 60 AND 90 MINUTE FIRE RATED DOORS

A. Fabrication:

1. General: Fabricate as specified for standard doors, NWWDA IS 1.4, and UL requirements for fire rating shown.

2. Non-Ratable Openings: If any scheduled fire rated door cannot be labeled because of design, size, hardware, or other reason, give written notification; do not start fabrication until conflict is resolved.

B. Core: Door manufacturer's standard non-combustible mineral core, containing 0-percent asbestos and designed to meet or exceed labeling requirements.

1. Concealed Rod Hardware: Where scheduled, provide Georgia-Pacific, or equal, Firestop components; including matching full length wood

edge meeting stiles with no visible finger joints, 1/2-inch width after trimming. Metal edges or metal edge and astragal no acceptable.

2. Reinforcement: Manufacturer's standard size, incombustible multi-ply inner blocking to eliminate through-bolting of surface mounted hardware.

a. Stile Edge Screw Withdrawal: Minimum 740-pounds when tested per ASTM D-1037.

3. Stile Edge Split Resistance: Minimum 750-pounds minimum when tested per ASTM D-143 (modified). For wood veneer doors, provide 1/2-inch-thick outer band matching specified wood veneer.

a. Reinforce hinge edge on all fire doors to accommodate full-mortise hinges as specified and to provide additional screw holding power when hinge is installed.

C. Cross Bands and Edge Bands: Untreated or fire retardant treated per UL requirements for fire rating shown.

D. Identification: Stamp each door with NWWDA Certification Hallmark.

1. Fire Rated Doors: Provide each door with UL or WHI metal or mylar type labels.

E. Install flush stainless steel edge guards under label procedure. Furnished by section 087100 – Door Hardware.

F. Install Electro Lynx wiring and Molex. Type connectors under label procedure. Furnished by section 087100 – Door Hardware.

2.7 VISION PANEL FRAMES

A. General: Provide where shown; square profile moldings, unless otherwise shown.

B. Standard Doors:

1. General: Solid stock hardwood; flush type, unless otherwise shown.

2. Transparent Finish: Same grade and species to match face.

C. Glazing Materials: Provided under Section 088000 – Glazing.

2.8 GLASS AND GLAZING

A. Vision Glass: Rated and Non-rated vision glass specified in Section 088000 – Glazing.

2.9 SIZES AND CLEARANCES

A. Sizes: As shown; coordinate with installation to determine actual door sizes and clearances.

1. Door Thickness: 1-3/4-inch, unless otherwise shown.

B. Clearances: Maximum 1/8-inch clearance at jambs, heads, and meeting stiles; maximum 1/4-inch clearance over thresholds, and maximum 3/8-inch clearance in openings without thresholds; unless otherwise shown. Bevel vertical edges 1/8-inch per 2 inches.

2.10 PRE-FITTING AND PREMACHINING

A. General: Pre-fit and pre-machine.

B. Pre-fitting: Pre-fit at factory per specified clearances. Provide stile edges with standard bevel or radius as required by hardware.

C. Pre-machining: Coordinate with Section 087100 – Door Hardware, and DIVISION 26 - Electrical Security Requirements, including:

1. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W Series standards, and hardware templates.

2. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.

2.11 PRESEALING FOR PAINTED FINISHES

A. Opaque Finished Doors:

1. General: Manufacturer's standard clear sealer or pigmented alkyd base primer sealer; verify compatibility with Section 099123 – Interior Painting.

2. Sealer or Primer Sealer: One coat; apply to top and bottom rails and hardware cutouts.

3. Opaque Finish: Shop or Field Paint as shown on Drawings and as specified in Section 099123 – Interior Painting.

PART 3 - EXECUTION

3.1 PREPARATION

A. General: Do not install doors until cementitious work in areas shown to receive wood doors is completed and dry.

B. Environmental Requirements: Condition doors to normal occupancy conditions prior to hanging. Do not subject doors to abnormal heat, dryness, or humidity.

D. Examine doors and substrates, with Installer present, for suitable conditions where wood doors will be installed.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with plumb jambs and level heads.

2. Reject doors with defects.

3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Cut, trim, and hang doors to fit into frames with specified clearances. Recoat top and bottom edges prior to hanging, if affected by fitting; use same type paint as applied at factory.

B. Prefinished Doors: Cutting, trimming, fitting, and machining not permitted.

C. Operation: Rehang or replace doors that do not swing or operate freely.

E. Finished Doors: Replace doors that are damaged or do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION

SECTION 08 41 00 – ALUMINUM STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following types of aluminum entrance and storefront work:
1. Interior windows.
2. Shoes for interior partitions.

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Section 079200 "Joint Sealants" for sealing between storefront system and the substrate.
2. Section 088000 "Glazing" for requirements for aluminum entrances and storefront, including entrances specified to be factory glazed and fire rated openings.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

A. General: Provide aluminum entrance and storefront assemblies that comply with performance characteristics specified, as demonstrated by testing the manufacturer's corresponding stock assemblies according to test methods indicated.

C. Structural Performance: Conduct tests for structural performance in accordance with ASTM E 330. At the conclusion of the tests there shall be no glass breakage or permanent damage to fasteners, anchors, hardware or actuating mechanism. Framing members shall have no permanent deformation in excess of 0.2 percent of their clear span.
1. Deflection Normal to the Plane of the Wall: Test pressure required to measure deflection of framing members normal to the plane of the wall shall be equivalent to the wind load specified above. Deflection shall not exceed 1/175 of the clear span, when subjected to uniform load deflection test.
2. Deflection Parallel to the Plane of the Wall: Test pressures required to measure deflection parallel to the plane of the wall shall be equal to 1.5 times the wind pressures specified above. Deflection of any member carrying its full dead load shall not exceed an amount that will reduce glass bite below 75 percent of the design dimension and shall not reduce the edge clearance between the member and the fixed panel, glass or other

fixed member above to less than 1/8 inch. The clearance between the member and an operable door or window shall be at least 1/16 inch.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.

B. Product Data: Product data for each aluminum entrance and storefront system required, including:
1. Manufacturer's standard details and fabrication methods.
2. Data on finishing, hardware and accessories.
3. Recommendations for maintenance and cleaning of exterior surfaces.

D. Shop Drawings: Shop drawings for each aluminum entrance and storefront system required, including:
1. Layout and installation details, including relationship to adjacent work.
2. Elevations at 1/4-inch scale.
3. Detail sections of typical composite members.
4. Anchors and reinforcement.
5. Hardware mounting heights.
6. Provisions for expansion and contraction.
7. Glazing details.

E. Hardware Schedule: Submit complete hardware schedule organized into sets based on hardware specified. Coordinate hardware with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish. Include item name, name of the manufacturer and complete designations of every item required for each door opening.

F. Samples for Color Selection: Submit pairs of samples of each specified color and finish on 12-inch-long sections of extrusions or formed shapes. Where normal color variations are anticipated, include 2 or more units in each set of samples indicating extreme limits of color variations.

G. Test Reports: Provide certified test reports from a qualified independent testing laboratory showing that aluminum entrance and storefront systems have been tested in accordance with specified test procedures and comply with performance characteristics indicated.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed installations of aluminum storefront and entrances similar in design and extent to those required for the project and whose work has resulted in construction with a record of successful in-service performance.

B. Manufacturer's Qualifications: Provide aluminum entrances and storefront systems produced by a firm experienced in manufacturing systems that are similar to those
indicated for this project and that have a record of successful in-service performance.

C. Single Source Responsibility: Obtain aluminum entrance and storefront systems from one source and from a single manufacturer.

D. Design Criteria: The drawings indicate the size, profile, and dimensional requirements of aluminum entrance and storefront work required and are based on the specific types and models indicated. Aluminum entrance and storefront by other manufacturers may be considered, provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect. The burden of proof of equality is on the proposer.

E. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to aluminum windows including, but not limited to, the following:
1. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review required testing and inspecting procedures.
4. Review hardware requirements and installation procedures.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver aluminum entrance and storefront components in the manufacturer's original protective packaging.

B. Store aluminum components in a clean dry location away from uncured masonry or concrete. Cover components with waterproof paper, tarpaulin or polyethylene sheeting in a manner to permit circulation of air.
1. Stack framing components in a manner that will prevent bending and avoid significant or permanent damage.

1.7 PROJECT CONDITIONS

A. Field Measurements: Check openings by accurate field measurement before fabrication. Show recorded measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of the work
1. Where necessary, proceed with fabrication without field measurements, and coordinate fabrication tolerances to ensure proper fit.

1.8 WARRANTY

A. Special Assembly Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that deteriorate as defined in this Section within specified warranty period.
1. Failures include, but are not limited to, the following.
a. Structural failures including, but not limited to, excessive deflection.
b. Noise or vibration caused by thermal movements.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

d. Water leakage through fixed glazing and framing areas.
e. Failure of operating components to function properly.
f. Warranty Period: Five years from date of Substantial Completion.
2. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.
a. Warranty Period: 2 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers - Standard Systems: Subject to compliance with requirements, manufacturers offering entrance and storefront systems that may be incorporated in the work include the following:
1. Kawneer North America, an Alcoa Company.
2. Arcadia Incorporated.
3. C.R. Laurence - US Aluminum Corp.
4. EFCO Corporation, a Pella Company.
5. Oldcastle Building Envelope Corporation

2.2 MATERIALS

A. Aluminum Members: Alloy and temper recommended by the manufacturer for strength, corrosion resistance, and application of required finish; comply with ASTM B 221 for aluminum extrusions, ASTM B 209 for aluminum sheet or plate, and ASTM B 211 for aluminum bars, rods and wire.

B. Carbon Steel: Carbon steel reinforcement of aluminum framing members shall comply with ASTM A 36 for structural shapes, plates and bars, ASTM A 611 for cold rolled sheet and strip, or ASTM A 570 for hot rolled sheet and strip.

C. Glass and Glazing Materials: Comply with requirements of "Glass and Glazing" section of these specifications.

D. Fasteners: Provide fasteners of aluminum, nonmagnetic stainless steel, zinc plated steel, or other material warranted by the manufacturer to be noncorrosive and compatible with aluminum components, hardware, anchors and other components.

1. Reinforcement: Where fasteners screw-anchor into aluminum members less than 0.125 inches thick, reinforce the interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard noncorrosive pressed-in splined grommet nuts.
2. Exposed Fasteners: Do not use exposed fasteners except for application of hardware. For application of hardware, use Phillips flat-head machine screws that match the finish of member or hardware being fastened.

E. Concealed Flashing: 0.0179-inch (26 gage) minimum dead-soft stainless steel, or 0.026-inch-thick minimum extruded aluminum of alloy and type selected by manufacturer for compatibility with other components.

F. Brackets and Reinforcements: Provide high-strength aluminum brackets and reinforcements; where use of aluminum is not feasible provide nonmagnetic stainless steel or hot-dip galvanized steel complying with ASTM A 123.

H. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.

2.3 ALUMINUM STOREFRONT HARDWARE SCHEDULE

A. General: Install the items in the amounts indicated on the Drawings and schedules for a complete and operable facility.

2.4 COMPONENTS

A. Storefront Framing System: Provide storefront and entrance framing systems fabricated from extruded aluminum members of size and profile indicated. Include subframes and other reinforcing members of the type indicated. Provide for storefront glazed from the exterior on all sides with projecting stops as scheduled. Shop-fabricate and preassemble frame components where possible. Provide storefront frame sections without exposed seams.

1. Mullion Configurations: Provide pockets at the inside glazing face to receive resilient elastomeric glazing. Mullions and horizontals shall be one piece.

2. Basis of Design: Subject to compliance with requirements of Contract Documents, provide product by manufacturer listed below
1. Manufacturer: **Kawneer** North America, an Alcoa company.
2. Product:
a. Framing: **Trifab VersaGlaze 451.**
b. Doors/Entrances: **500 Heavy Wall.**

2.5 FABRICATION

A. General: Fabricate aluminum entrance and storefront components to designs, sizes and thicknesses indicated and to comply with indicated standards. Sizes and profile requirements are indicated on the drawings. Variable dimensions are indicated, with maximum and minimum dimensions required, to achieve design requirements and coordination with other work.

B. Prefabrication: Complete fabrication, assembly, finishing, hardware application, and other work to the greatest extent possible before shipment to the Project site. Disassemble components only as necessary for shipment and installation.
1. Perform fabrication operations, including cutting, fitting, forming, drilling and grinding of metal work to prevent damage to exposed finish surfaces. Complete these operations for hardware prior to application of finishes.
2. Do not drill and tap for surface-mounted hardware items until time of installation at project site.

C. Welding: Comply with AWS recommendations. Grind exposed welds smooth to remove weld spatter and welding oxides. Restore mechanical finish.

1. Welding behind finished surfaces shall be performed in such a manner as to minimize distortion and discoloration on the finished surface.

D. Reinforcing: Install reinforcing as required for hardware and as necessary for performance requirements, sag resistance and rigidity.

E. Dissimilar Metals: Separate dissimilar metals with bituminous paint, or a suitable sealant, or a nonabsorptive plastic or elastomeric tape, or a gasket between the surfaces. Do not use coatings containing lead.

F. Continuity: Maintain accurate relation of planes and angles with hairline fit of contacting members.

G. Fasteners: Conceal fasteners wherever possible.

H. Weather stripping: At interior locations without weather stripping, provide neoprene silencers on stops to prevent metal-to-metal contact.

2.6 FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. AA Designations: Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.

D. Clear Anodic Finish – Interior Surfaces: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and supports, with the Installer present, for compliance with requirements indicated, installation tolerances, and other conditions that affect installation of aluminum entrances and storefronts. Correct unsatisfactory conditions before proceeding with the installation.
1. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation.
B. General: Set units plumb, level, and true to line, without warp or rack of framing members, doors, or panels. Install components in proper alignment

and relation to established lines and grades indicated. Provide proper support and anchor securely in place.

C. Construction Tolerances: Install aluminum entrance and storefront to comply with the following tolerances:
1. Variation from Plane: Do not exceed 1/8 inch in 12 feet of length or 1/4 inch in any total length.
2. Offset from Alignment: The maximum offset from true alignment between two identical members abutting end to end in line shall not exceed 1/16 inch.
3. Diagonal Measurements: The maximum difference in diagonal measurements shall not exceed 1/8 inch.
4. Offset at Corners: The maximum out-of-plane offset of framing at corners shall not exceed 1/32 inch.

D. Separate aluminum and other corrodible metal surfaces from sources of corrosion or electrolytic action at points of contact with other materials.
1. Zinc or cadmium plate steel anchors and other unexposed fasteners after fabrication.
2. Paint dissimilar metals where drainage from them passes over aluminum.
3. Paint aluminum surfaces in contact with mortar, concrete or other masonry with alkali resistant coating.
4. Paint wood and similar absorptive material in contact with aluminum and exposed to the elements or otherwise subject to wetting, with two coats of aluminum house paint. Seal joints between the materials with sealant.

E. Drill and tap frames and doors and apply surface-mounted hardware items. Comply with hardware manufacturer's instructions and template requirements. Use concealed fasteners wherever possible.

F. Set sill members and other members in bed of sealant as indicated, or with joint fillers or gaskets as indicated to provide weathertight construction. Comply with requirements of Division 7 for sealants, fillers, and gaskets.

G. Refer to "Glass and Glazing" Section of Division 8 for installation of glass and other panels indicated to be glazed into doors and framing, and not preglazed by manufacturer.

3.3 ADJUSTING

A. Adjust operating hardware to function properly, for smooth operation without binding, and for weathertight closure.

3.4 CLEANING

A. Clean the completed system, inside and out, promptly after installation, exercising care to avoid damage to coatings.

B. Clean glass surfaces after installation, complying with requirements contained in the "Glass and Glazing" Section for cleaning and maintenance. Remove excess glazing and sealant compounds, dirt and other substances from aluminum surfaces.

3.5 PROTECTION

A. Institute protective measures required throughout the remainder of the construction period to ensure that aluminum storefronts will be without damage or deterioration, other than normal weathering, at time of acceptance.

END OF SECTION

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes commercial door hardware for the following:

1. Swinging doors.
2. Sliding doors.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical door hardware.
3. Automatic operators.

C. Related Sections:

1. Division 08 Section “Hollow Metal Doors and Frames”.
2. Division 08 Section “Flush Wood Doors”.
3. Division 08 Section “Aluminum-Framed Entrances and Storefronts”.
4. Division 08 Section “Automatic Door Operators”.
5. Division 28 Section “Access Control Hardware Devices”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.
7. UL/ULC and CSA C22.2 - Standards for Automatic Door Operators Used on Fire and Smoke Barrier Doors and Systems of Doors.
8. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:

1. ANSI/BHMA Certified Product Standards - A156 Series.
2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
3. ANSI/UL 294 - Access Control System Units.
4. UL 305 - Panic Hardware.
5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
3. Content: Include the following information:

    a. Type, style, function, size, label, hand, and finish of each door hardware item.
    b. Manufacturer of each item.
    c. Fastenings and other pertinent information.
    d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
    e. Explanation of abbreviations, symbols, and codes contained in schedule.
    f. Mounting locations for door hardware.
    g. Door and frame sizes and materials.
    h. Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
b. Complete (risers, point-to-point) access control system block wiring diagrams.
c. Wiring instructions for each electronic component scheduled herein.

2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Proof of Certification: Provide copy of manufacturer(s) official certification or accreditation document indicating proof of status as a qualified and authorized provider of the primary Integrated Wiegand Access Control Products.

E. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

1.4 CLOSEOUT SUBMITTALS

A. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

B. Project Record Documents: Provide record documentation of as-built door hardware sets in digital format (.pdf, .docx, .xlsx, .csv) and as required in Division 01, Project Record Documents.

1.5 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).

C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during

the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

E. Integrated Wireless, and IP-Enabled Access Control Products Supplier Qualifications: Integrated access control products and accessories are required to be supplied and installed through current members of the ASSA ABLOY "Authorized Channel Partner" (ACP) and "Certified Integrator" (CI) programs. Suppliers are to be factory trained, certified prior to project bid, and a direct purchaser of the specified product. Installers are to be factory trained, certified prior to project bid, and are responsible for commissioning, servicing, and warranting the installed equipment specified for the project.

F. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

G. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.

H. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

I. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

J. At completion of installation, provide written documentation that components were applied according to manufacturer's instructions and recommendations and according to approved schedule.

1.6 DELIVERY, STORAGE AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.7 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.

C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.8 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

4. Electrical component defects and failures within the systems operation.

C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Hardware shall not have any visible manufacturer names on exposed materials, except cylinders, when the door is in a closed position.

2.2 BUTT HINGES

A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:

a. Two Hinges: For doors with heights up to 60 inches.
b. Three Hinges: For doors with heights 61 to 90 inches.
c. Four Hinges: For doors with heights 91 to 120 inches.
d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.
b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following:

a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for all out-swinging lockable doors.

5. Manufacturers:

a. McKinney (MK) - TA/T4A Series, 5-knuckle.

2.3 POWER TRANSFER DEVICES

A. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:

   a. Pemko (PE) - EL-CEPT Series.
   b. Securitron (SU) - EL-CEPT Series.

B. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

1. Provide one each of the following tools as part of the base bid contract:

   a. McKinney (MK) - Electrical Connecting Kit: QC-R001.
   b. McKinney (MK) - Connector Hand Tool: QC-R003.

2. Manufacturers:

   a. McKinney (MK) - QC-C Series.

2.4 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

1. Manufacturers:

   a. Match Existing, Field Verify.
   b. No Substitution.

B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:

1. Threaded mortise cylinders with rings and cams to suit hardware application.
2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
4. Tubular deadlocks and other auxiliary locks.

5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
6. Keyway: Match Facility Standard.

C. Keying System: Each type of lock and cylinders to be factory keyed.

1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
3. Existing System: Field verify and key cylinders to match Owner's existing system.

D. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Three (3).
2. Master Keys (per Master Key Level/Group): Five (5).
3. Construction Keys (where required): Ten (10).

E. Construction Keying: Provide construction master keyed cylinders.

F. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

2.5 MORTISE LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): Provide ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed mortise locksets. Listed manufacturers shall meet all functions and features as specified herein.

1. Manufacturers:

a. Corbin Russwin Hardware (RU) - ML2000 Series.
b. dormakaba BEST (BE) - 45H Series.
c. Sargent Manufacturing (SA) - 8200 Series.

2.6 CYLINDRICAL LOCKS AND LATCHING DEVICES

A. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Operational Grade 1 Certified Products Directory (CPD) listed cylindrical locksets. Listed manufacturers shall meet all functions and features as specified herein.

1. Provide locksets with functions and features as follows:

a. Meets ANSI/BHMA A156.41 for single motion egress.
b. Where required by code, provide knurling or abrasive coating on all levers leading to hazardous areas.

c. Meets UL and CUL Standard 10C Positive Pressure, Fire Test of Door Assemblies with levers that meet A117.1 Accessibility Code.
d. Exceeds ANSI/BHMA A156.2 requirements by 2.6 times for 3,100 in-lb. abusive locked lever torque with no entry while maintaining egress.
e. Exceeds ANSI/BHMA A156.2 requirements by 8 times for 1,600 lbs. offset lever pull with no entry for protection against attacks.
f. Exceeds ANSI/BHMA A156.3 requirements by 2 times for latch retraction with 100 lb. preload while maintaining operation in warped doors.
g. Exceeds ANSI/BHMA A156.3 requirements by 20 times for no access with minimum 100 vertical impacts for protection against vandalism attempts.
h. Independent return springs allow lock to exceed ANSI/BHMA A156.2 Grade 1 cycle requirements without lever sag.
i. Status indicators inside, outside, or on both sides of doors as specified with high visibility red/green or red/white icons to display locked or unlocked state in the rose.
j. Ten-year limited warranty for mechanical functions.

2. Manufacturers:

a. Corbin Russwin Hardware (RU) - CLX3300 Series.
b. dormakaba BEST (BE) - 9K Series.
c. Sargent Manufacturing (SA) - 10X Line.

2.7 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.8 SURFACE DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard..

1. Manufacturers:

    a. Corbin Russwin Hardware (RU) - DC6000 Series.
    b. LCN Closers (LC) – 4040XP Series.
    c. Norton Rixson (NO) - 7500 Series.
    d. Sargent Manufacturing (SA) - 351 Series.

C. Door Closers, Surface Mounted (Cam Action): ANSI/BHMA 156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, high efficiency door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be of the cam and roller design, one piece cast aluminum silicon alloy body with adjustable backcheck and independently controlled valves for closing sweep and latch speed.

1. Manufacturers:

    a. Corbin Russwin (RU) - DC5000 Series.
    b. Norton Rixson (NO) - 2800ST Series.
    c. Sargent Manufacturing (SA) - 422 Series.

2.9 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1” LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
3. Where plates are applied to fire rated doors with the top of the plate more than 16” above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer’s catalog and template book for specific requirements for size and applications.
4. Protection Plates: ANSI/BHMA A156.6 protection plates (kick, armor, or mop), fabricated from the following:

    a. Stainless Steel: 300 grade, 050-inch thick.

5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
6. Manufacturers:

    a. Rockwood (RO).

2.10 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Manufacturers:

    a. Rockwood (RO).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Manufacturers:

    a. Norton Rixson (RF).
    b. Rockwood (RO).
    c. Sargent Manufacturing (SA).

2.11 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NFPA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers:

1. Pemko (PE).

2.12 ELECTRONIC ACCESSORIES

A. Intelligent Switching Power Supplies: Provide the least number of power supplies at the appropriate amperage level sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.

1. Power supplies shall meet all functions and features as specified herein.

a. UL listed dual voltage 12 or 24 VDC field selectable continuous output.
b. Dedicated fast charger to prolong battery life with low battery cutoff to protect batteries from deep discharge.
c. Enhanced surge immunity for input/output protection
d. Separate, dedicated battery charging circuit to keep locks cooler.
e. Dual-color LED visual notification to prevent applying incorrect voltages to the power supply.
f. Instant auto-switch to battery on AC loss.
g. Expandable up to 16 outputs in the standard enclosure

h. Integrated fire alarm interface to allow main output shutdown or disconnect on a per output basis when using an R8 output module.
i. Network ready and remotely manage locks and connected devices when using an M8 managed output module on network models.
j. Lifetime replacement, no-fault, no questions asked warranty.

2. Manufacturers:

a. Securitron (SU) - AQL Series.

2.13 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.14 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Integrated Wiegand access control products are required to be installed through current members of the ASSA ABLOY "Certified Integrator" (CI) program.

D. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

E. Push Plates and Door Pulls: When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.

F. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

G. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.
2. The supplier is responsible for handing and sizing all products.
3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Manufacturer’s Abbreviations:

1. MK - McKinney
2. SU - Securitron
3. RU - Corbin Russwin
4. OT - Other
5. RF - Rixson
6. NO - Norton
7. BM - Besam
8. RO - Rockwood
9. PE - Pemko

Hardware Sets

Set: 1.0
Doors: A103A, A104A, A106A, A107A

3	Hinge, Full Mortise, Hvy Wt	T4A3786	US26D	MK	
1	Office Lock	CLX3351 NZD LC	626	RU	
1	Keyed Cylinder	Match/expand existing-type as required		OT	
1	Wall Stop	406	US32D	RO	
1	Gasketing	By door manufacturer		OT	

Set: 2.0
Doors: A105A

3	Hinge, Full Mortise, Hvy Wt	T4A3786	US26D	MK	
1	Electric Power Transfer	EL-CEPT	630	SU	⚡
1	EAC Cyl Lock BY DIVISION 28	CLX33605-SN210 NZD BIPS LC	626	RU	⚡
1	Keyed Cylinder	Match/expand existing-type as required		OT	
1	Surface Closer	7500	689	NO	
1	Kick Plate	K1050 10" CSK	US32D	RO	
1	Wall Stop	406	US32D	RO	
3	Silencer	608-RKW		RO	
1	Frame Harness	QC-C3000P		MK	⚡
1	Door Harness	QC-C__P		MK	⚡
1	Power Supply	AQL By security contractor		SU	⚡

Notes: This integrated access control device requires certification to purchase and install; to be provided and installed by certified security integrator only.

Door normally closed and locked.| Exterior access by presenting valid credential to reader, momentarily releasing trim for entry. | Free egress at all times. | REX in lock shunts alarm. | Door monitored for position (DPS included with lock). | Electrified lock trim is fail secure and remains locked during power loss or alarm state.

Set: 3.0
Doors: A115A, A125A

3	Hinge, Full Mortise, Hvy Wt	T4A3786	US26D	MK

1	Indicator Privacy Lock	CLX3330 NVSL V33	626	RU
1	Surface Closer	2800ST	689	NO
1	Mop Plate	K1050 6" CSK	US32D	RO
1	Kick Plate	K1050 10" CSK	US32D	RO
1	Wall Stop	406	US32D	RO
1	Gasketing	S44BL		PE
1	Coat Hook	796	US26D	RO

Set: 4.0
Doors: A112B, A113B, A114B, A116B, A117B, A118B, A122A, A123A, A124A, A126A, A127A, A128A, A130A

3	Hinge, Full Mortise	TA2714	US26D	MK
1	Passage Latch	CLX3310 NZD	626	RU
1	Surf Overhead Stop	9-_36	689	RF
1	Gasketing	S44BL		PE
1	Auto Door Bottom	STC411APK		PE

Set: 5.0
Doors: A102A

3	Hinge, Full Mortise, Hvy Wt	T4A3786	US26D	MK
1	Passage Latch w/MELR	ML2010 NSA MELR	626	RU ⚡
1	Single Door Operator	SW200i	689	BM ⚡
1	Kick Plate	K1050 10" CSK	US32D	RO
1	Wall Stop	406	US32D	RO
1	Gasketing	S44BL		PE
1	Frame Harness	QC-C3000P		MK ⚡
1	Door Harness	QC-C__P		MK ⚡
1	Wave to Open Wall Switch	700		NO ⚡
1	Power Supply	AQL By security contractor		SU ⚡

Notes: Automatic door operation by wave to open switch on corridor side, momentarily retracting latch to allow opener to function.

Set: 6.0
Doors: A108A, A109A, A112A, A113A, A114A, A116A, A117A, A118A, A122B, A123B, A124B, A126B, A127B, A128B

1	Hardware	By AD Systems	OT

END OF SECTION 087100

SECTION 087113 - AUTOMATIC DOOR OPERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Low energy automatic door operators for swinging doors.

B. Related Sections:

1. Division 01 Section "General Conditions".
2. Division 01 Section "Cash Allowances".
3. Division 01 Section "Product Allowances".
4. Division 01 Section "Closeout Procedures".
5. Division 08 Section “Door Schedule”.
6. Division 08 Section “Hollow Metal Doors and Frames”.
7. Division 08 Section “Flush Wood Doors”.
8. Division 08 Section “Door Hardware”.
9. Division 08 Section “Access Control Hardware”.
10. Division 26 Section “Electrical”.

A. Codes and Standards: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ANSI/BHMA A156.4 - Door Controls, Door Closers.
3. ANSI/BHMA A156.19 - Power Assist and Low-Energy Power Operated Doors.
4. ICC/IBC - International Building Code.
5. NFPA 70 - National Electrical Code.
6. NFPA 80 - Fire Doors and Windows.
7. NFPA 101 - Life Safety Code.
8. NFPA 105 - Installation of Smoke Door Assemblies.
9. UL/ULC and CSA C22.2 – Standards for Automatic Door Operators Used on Fire and Smoke Barrier Doors and Systems of Doors.
10. UL 325 - Door, Drapery, Gate, Louver, and Window Operators and Systems.
11. State Building Codes, Local Amendments.

1.3 PERFORMANCE REQUIREMENTS

A. Automatic door operators to be used on interior or exterior doors; up to 200 pounds (91 kg) weight and maximum door width of 48" (1219 mm).

1. Auto door operator capable of operating within temperature ranges of -22°F (-30°C) and 122°F (50°C).

1.4 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, and finishes for automatic door operators, including activation devices. Include operating characteristics, electrical characteristics, and furnished accessories.

B. Shop Drawings: Include details and attachments to other work.

1. Include locations and elevations of each unique entrance showing activation devices.
2. Indicate required clearances, components, and location and size of field connections.
3. Wiring Diagrams: For power, signal, and activation wiring.

C. Qualification Data: Provide copy of manufacturer's official certification or accreditation document indicating proof of status as a qualified and authorized installer of automatic door operators and accessories.

D. Operating and Maintenance Manuals: Provide manufacturer's operating and maintenance manual for each item comprising the automatic door operator installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturer and Installer providing the operators and installation. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.

E. Warranties and Maintenance: Special warranties and maintenance agreements specified in this Section.

1.5 COORDINATION

A. Electrical Systems Coordination: Coordinate the layout and installation of scheduled automatic door operators and related activation devices, with required connections to source power junction boxes, remote power supplies, access control equipment, detection and monitoring hardware, and fire alarm system.

B. Templates: Obtain and distribute to the parties involved, templates for doors, frames, operators, and other work specified to be factory prepared and reinforced for installing automatic door operators. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing automatic door operators to comply with indicated requirements.

C. Door and Frame Preparation: Related Division 08 Sections (Steel, Aluminum and Wood) doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive

the installation of the specified automatic door operators without additional in-field modifications.

1.6 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Warranty: Written warranty, executed by manufacturer, agreeing to repair or replace components of automatic door operators that fail in materials or workmanship within specified warranty period after final acceptance by Owner. Failures include, but are not limited to, the following:

1. Faulty or sporadic operation of automatic door operator, including activation and safety devices.
2. Deterioration of metals, metal finishes, and other materials beyond normal weathering or use.

C. Special Warranty Period: Two years from date of Substantial Completion.

D. Provide extended warranty from defects in material or workmanship under normal use for a period of 3 years from the date of substantial completion for units installed by a certified ASSA ABLOY Power Operator Preferred Installer in accordance with the manufacturer's written warranty certificate.

1.7 MAINTENANCE SERVICE

A. Maintenance Service: Beginning at Substantial Completion, and running concurrent with the specified warranty period, provide continuous (6) months full maintenance by skilled employees of automatic door operator Installer. Include planned and preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door operation. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.

B. Extended Maintenance Support and Service Agreement: Submit for Owner’s consideration an optional extended Service Agreement for the installed automatic door operator system. The extended Service Agreement is considered elective and is without manufacturer's requirement stipulating mandatory coverage for owner and/or vendor system support.

1. A published copy of this agreement to be included with the submittal package
2. Support for the installed automatic door operator system is provided through the vendor under a specified, limited 24 hour support program.
3. Automatic door operators and components are to be available on a one-day turn around time frame from the vendor.

PART 2 - PRODUCTS

2.1 ELECTROMECHANICAL DOOR OPERATORS

A. General: Provide low energy operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for compliance with UL 325. Coordinate operator mechanisms with door operation, hinges, and activation devices.

1. Fire-Rated Doors: Provide door operators for fire-rated door assemblies that comply with NFPA 80 for fire-rated door components and are listed and labeled by a qualified testing agency.

B. Standard: Certified ANSI/BHMA A156.19.

C. Performance Requirements:

1. Opening Force if Power Fails: Not more than 15 lbf required to release a latch if provided, not more than 30 lbf required to manually set door in motion, and not more than 15 lbf required to fully open door.
2. Entrapment Protection: Not more than 15 lbf required to prevent stopped door from closing or opening.

D. Configuration: Surface mounted or in-ground as required. Door operators to control single swinging and pair of swinging doors.

E. Operation: Power opening and spring closing operation capable of meeting ANSI A117.1 accessibility guideline. Provide time delay for door to remain open before initiating closing cycle as required by ANSI/BHMA A156.19.

F. Features: Operator units to have full feature adjustments for door opening and closing force and speed, backcheck, motor assist acceleration from 0 to 30 seconds, time delay, vestibule interface delay, obstruction recycle, and hold open time from 0 up to 30 seconds.

G. Provide outputs and relays on board the operator to allow for coordination of exit device latch retraction, electric strikes, magnetic locks, card readers, safety and motion sensors and specified auxiliary contacts.

H. Brackets and Reinforcements: Manufacturer's standard, fabricated from aluminum with nonferrous shims for aligning system components.

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

1. Besam Automated Entrance Systems (BE) – SW200i Series.

2.2 ACTIVATION DEVICES

A. General: Provide activation devices in accordance with ANSI/BHMA A156.19 standard, for condition of exposure indicated and for long term, maintenance free operation under normal

traffic load operation. Coordinate activation control with electrified hardware and access control interfaces. Activation switches are standard SPST, with optional DPDT availability.

B. Touch Less Wall Switch: Momentary contact door control switch with movement required activation. Single or double gang box junction box mounting.

1. Doppler radar sensor.
2. Mounting Location: As indicated on Drawings.
3. Manufacturers:

a. BEA Sensors (BS) – MS Series.
b. Norton Rixson (NO) – 700 Series.

2.3 ACCESSORIES

A. Signage: As required by cited ANSI/BHMA A156.19 standard for the type of operator.

2.4 FINISHES

A. Standard: Designations used to indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware. Units will be sprayed with a combination of waterborne acrylic and polyester powder coat.

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.5 OPENING LABELS

A. Provide 1"W x 2"H gloss polyester label imprinted with door mark and QR-type code readable via IR and visible light scan. QR code links to a security credential protected site displaying the installed door opening information. Label constructed with a high-performance, permanent acrylic adhesive resistant to chemicals, smear and scratch, and repeated freeze and thaw cycles. Face stock of label to be white or clear coated, 2.0 mil thickness with tensile strength meeting or exceeding 18,000 psi.

1. Approved Manufacturer: Openings Studio™ Smart Tags (AA).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, door and frame preparation and reinforcements, power connections, electrical systems interfaces, and other conditions affecting performance of automatic door operators.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 INSTALLATION

A. General: Install complete automatic door operators according to manufacturer's written instructions and ANSI/BHMA A156;19 standard, including activation devices, control wiring, remote power units if any, connection to the building's fire alarm system, and required signage.

B. Power Connection: Reference Division 26 "Electrical" Sections for connection to electrical power distribution system.

C. Access Control System: Coordinate connections and operation with access control system

D. Signage: Apply signage as required by ANSI/BHMA A156.19 standard for type of door operator and direction of pedestrian travel.

3.3 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.
2. Submit documentation of incomplete items in the following formats:

    a. PDF electronic file.
    b. Electronic formatted file integrated with the Openings Studio™ door opening management software platform.

3.4 ADJUSTING

A. Comply with requirements of ANSI/BHMA A156.19 standard. Adjust automatic door operators to function smoothly, and lubricate as recommended by manufacturer.

3.5 DEMONSTRATION

A. Certified Installer's representative to provide eight (8) hours of training to Owner's maintenance personnel in the proper adjustment, operation, and maintenance of automatic door operators.

END OF SECTION 087113

SECTION 088000 – GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish labor, materials, tools, equipment, and services for Interior Glass and Glazing in accordance with provisions of Contract Documents.

B. Completely coordinate with work of other trades.

1.2 QUALITY ASSURANCE

A. Glass Standards:
   1. ANSI Z97.1.
   2. CPSC 16 CFR 1201.
   3. GANA Glazing Manual.

B. Flat Glass ASTM C1036.
   1. Float glass: Type I, Quality q3 and Class 1 unless otherwise indicated.
   2. Figured glass: Type II, Quality q7, Form 3 and Class 1, Finish f1 and Pattern p2 unless otherwise indicated.
   3. Mirror glass and one-way vision glass: Type I, Quality q1 or q2, Class 1 and coated for purpose.

C. Flat Glass, Heat Treated, Coated and Uncoated, ASTM C1048.
   1. Heat strengthened glass: Kind HS, Type I, Quality q3, Class 1 and Condition A unless otherwise indicated.
   2. Tempered glass: Kind FT, Type I, Quality q3, Class 1 and Condition A unless otherwise indicated.

~~D. Mirror Glass:~~
   ~~1. ASTM C1503;~~
   ~~2. Quality: Mirror select.~~
   ~~3. F.S.DD-M-00411B (1).~~

~~E. Fire-Rated Assemblies:~~
   ~~1. General:~~
      ~~a. Where glazing products are used in fire-rated assemblies, comply with requirements of specific assembly specified in other sections of these Specifications.~~
      ~~b. Underwriters Laboratories, Inc. (UL):~~
         ~~1) UL 9 – Fire Tests of Window Assemblies.~~
         ~~2) UL 10B – Fire Tests of Door Assemblies.~~
         ~~3) UL 10C – Positive Pressure Fire Tests of Door Assemblies.~~
      ~~c. Fire Protective Rated Glass: Each lite shall bear permanent, non-removable label of UL certifying it for use in tested and rated fire protective assemblies.~~
   2. Door Assemblies:
      a. Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
      b. Positive Pressure Compliance: UL 10C.
      c. Fire Protective Glazing Products for Door Assemblies: Products identical to those tested per UL 10B, labeled and listed by UL.

3. Window Assemblies:
   a. Complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 257.
   b. Positive Pressure Compliance: UL 10C.

F. Laminated Glass:
   1. ASTM C1172 Standard Specification for Laminated Architectural Flat Glass.
   2. Laminated Glass Design Guide, by the Glass Association of North America (GANA).

G. Glazing Standards:
   1. Glazing Manual, by the Glass Association of North America (GANA).

1.3 SUBMITTALS

A. Samples:
   1. Provide one (1) 12 IN x 12 IN example of each specified type of glass.

B. Contract Closeout Information:
   1. Warranties.

C. Smoke baffle system:
   1. Shop drawing details, plans and elevations showing supports to building structure, interface at ceiling, blocking, baffle shoe, cap rail, grommet, cladding, sealant/adhesive, and glass.
   2. Product data.
   3. Standard warranty.
   4. Installation Instructions

1.4 WARRANTY

A. Written warranty signed by manufacturer or fabricator.

B. Laminated Glass:
   1. Five (5) years against deterioration including edge separation, delamination that materially obstructs vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

C. Fire-rated Ceramics:
   1. Five (5) year manufacturer's standard warranty.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Glass Products:
   1. Base:
      a. AGC Industries.
      b. Other manufacturers listed under (WC) on Interior Finish Schedule drawing A603A
   2. Optional:
      a. Guardian Industries.
      b. Pilkington.
      c. Vitro Architectural Glass.
      d. Saint-Gobain.

~~B. Fire-rated Glass Ceramic:~~

~~1. Base:~~
~~a. Technical Glass Products.~~
~~2. Optional:~~
~~a. Safti First.~~
~~b. Pilkington.~~
~~c. Saint-Gobain.~~

~~C. Radiation-resistant Glass:~~
~~1. Base:~~
~~a. Ray-Bar Engineering Corp.~~
~~2. Optional:~~
~~a. Nelco.~~
~~b. Corning Inc.~~
~~c. Schott North America, Inc.~~
~~d. Radiation Protection Products (RPP).~~

2.2 MATERIALS

A. Glass Materials:
1. Comply with indicated standards.
2. See Glass Types Schedule for listing of types.
3. Materials specified in Glass Types Schedules are minimum acceptable products.
4. Single manufacturer produce individual glass types used in fabrication of insulating units.
5. Manufacturer or fabricator determine if materials should be heat strengthened or fully tempered at non-hazardous locations that do not require safety glazing and provide accordingly.

B. Glazing Compounds:
1. Nonsag, nonstain type.
2. Pigmented to match frame units not requiring painting.
3. Compatible with adjacent surfaces.
4. For use in setting glass: Neutral-cure Silicone sealant.
5. Sealants:
a. Sealants shall have a VOC content no greater than 250 g/L.
b. Sealants shall contain no carcinogen or reproductive toxicant components present at more than 1% of total mass of the product as defined in the California Office of Environmental Health Hazard Assessment's (OEHHA) list entitled "Chemicals Known to the State to Cause Cancer" or the Reproductive Toxicity, Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65).
6. Sealant tape:
a. Butyl rubber sealant tape or ribbon having a continuous neoprene shim.
7. Gaskets:
a. Polyvinyl chloride or neoprene.
b. Extruded, flexible, of profile and hardness required to receive glass and provide a watertight installation.

C. Installation Setting Blocks and Spacers:
1. Neoprene, compatible with sealants used.
2. Setting blocks: 80-90 durometer.
3. Spacers: 40-50 durometer.
4. Compressible filler stock: Closed cell jacketed rod stock of synthetic rubber or plastic foam.

5. Shims, clips, springs, angles, beads, attachment screws and other miscellaneous items: As indicated or required.

2.3 GLASS TYPES SCHEDULE

A. Refer to Interior Glass Types Schedule and Interior Finish Schedule for basic description of Mark Numbers indicated on Drawing.

B. Refer to Drawings for depiction of unit sizes and locations.

C. Upgrade basic type conditions in accordance with following rules:
   1. Heat treatment upgrade based on physical size of unit:
      a. Heat strengthened or fully tempered units between 55 and 70 SF.
      b. Fully temper units exceeding 70 SF.
      c. Strengthen annealed glass where units exceed length or width limitations or both as recommended by glass manufacturer.
   2. Heat treatment upgrade based on locations which are potentially hazardous to occupants:
      a. Upgrade units to fully tempered, Kind FT, glass as required by any one of following:
         1) When required by local Codes.
         2) When specifically indicated on Drawings.
         3) Locations requiring Safety Glass, Kind FT, by 16 CFR 1201 and ANSI Z97.1:
            a) Units installed in doors, sash, transom or other operable units.
            b) Units where any part of unit is within 18 IN, measured vertically, above a floor line, sidewalk, paver, or other walking surface located within 3 FT of the glass unit, measured horizontally.
         4) Units in sidelights and other units located adjacent to and within 48 IN of either jamb of door or other operable units; this includes adjacent lites that are in perpendicular plane to door.
   3. Other conditions requiring heat treatment upgrades:
      a. Units which will be exposed to irregular sun or shade combinations or both shall be Kind HS or better.
      b. Where glass manufacturer recommends heat treatment coatings or tints specified.
      c. Where required to resist lateral loads.

2.4 INTERIOR GLASS TYPES

A. Annealed:
1. Clear float, 6mm (1/4 IN) thick.

B. Tempered:
1. Clear, fully-tempered tongue-less float, 6mm (1/4 IN) thick.

C. Laminated Fire and Safety Glass, 8mm:
1. Laminated, wireless, UL labeled for assembly indicated.
2. Impact-Safety Rated per ANSI Z97.1 and CPSC 16CFR1201.
3. Thickness: 8mm (5/16 IN), laminated.
4. Surface: Polished.
5. Base Product: FireLite Plus by Technical Glass Products.

~~**D. Mirror Glass:**~~
~~1. Color: Clear.~~
~~2. Thickness: 6mm (1/4 IN).~~
~~3. Unit Length and Width: As indicated on drawings.~~

4. ~~Annealed~~
5. ~~Tempered.~~

~~E. Radiation-Resistant Glazing:~~

1. ~~Composition: Lead-barium, polished float glass containing not less than 60 percent heavy metal oxides, including not less than 48 percent lead oxide by weight.~~
2. ~~Color: Clear.~~
3. ~~Provide glass units of sufficient thickness to provide same radiation shielding as adjacent wall areas. Provide single or multiple plies as necessary.~~

~~F. Laminated, Heat-Strengthened Glass:~~

1. ~~Laminated safety glass complying with ANSI Z97.1 and CPSC 16 CFR 1201, consisting of 2 sheets of heat strengthened float glass ASTM C1036, and 60 mil interlayer.~~

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine framing or glazing channel surfaces, backing, stop design, and conditions under which glazing is to be installed.

3.2 INSTALLATION

A. Do not install glass with edge damage.

B. Contractor is responsible for correct glass size for each opening, within tolerances and dimensions established.

C. Comply with recommendations of manufacturers, except where more stringent requirements are indicated.

D. Comply with GANA Glazing Manual.

E. Install sealants as recommended by sealant manufacturer.

F. Install setting blocks in adhesive or sealant.

G. Provide spacers inside and out, of proper size and spacing, for glass size, except where gaskets are used for glazing.

H. Minimum Bite:
   1. Monolithic, 6mm (1/4 IN) glass: 3/8 IN minimum bite.
   2. For other sizes: Refer to Table C of AAMA's Aluminum Curtain Wall Design Manual, Volume 6, Glass and Glazing.

I. Sealant Depth: Equal to sealant width.

J. Prevent sealant exudation from glazing channels.
   1. Leave void at heel or install filler at jambs and head.
   2. Do not leave void or install filler at sill.

K. Miter cut and bond gasket ends together at corners.

L. Immediately after installation, attach crossed streamers to framing held away from glass.

M. Do not apply anything to surfaces of glass.

N. Install spandrel units from exterior of building.

O. Installation of Mirrors:

1. Mastic Attachment: Install mirrors with mirror adhesive applied to back of mirror and pressed against substrate as recommended by mirror supplier.

P. Remove and replace damaged glass.

Q. Installation smoke baffle systems:
   1. Install in accordance with approved shop drawings.
   2. Follow manufacturers installation instructions.

3.3 CLEANING AND PROTECTION

A. Wash and polish glass on both faces not more than 7 days prior to final completion of work in each area.

B. Comply with glass manufacturer's recommendations and GANA 01-0300.

END OF SECTION

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
2. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

B. Related Requirements:
1. Section 054000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; roof rafters and ceiling joists; and roof trusses.

1.3 SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.

2. Protective Coating: ASTM A 653/A 653M, G40 (Z120) hot-dip galvanized unless otherwise indicated.

B. Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners.

1. Steel Studs and Runners (or Dimpled Steel Studs and Runners):
   a. Thickness: 33 Mil (structural) for floor to floor height of 16'-0" or less and use 54 Mil studs for more than 16'-0"; minimum, unless noted otherwise. **Use 16 GA studs at lead lined walls** unless noted otherwise.
   b. Depth: As indicated on Drawings.

C. Slip-Type Head Joints: Where indicated, provide one of the following:
1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
2. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Minimum Base-Metal Thickness: As indicated on Drawings.

E. Cold-Rolled Channel Bridging: Steel, 0.053-inch (1.34-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
1. Depth: 1-1/2 inches (38 mm).
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.

F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).
2. Depth: 7/8 inch (22.2 mm).

G. Resilient Furring Channels: 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound transmission.
1. Configuration: hat shaped.

H. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
1. Depth: 3/4 inch (19 mm).
2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch (0.8 mm).
3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

B. Hanger Attachments to Concrete:
   1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.
      a. Type: Post-installed, expansion anchor.
   2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.

C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.

D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch (1.34 mm) and minimum 1/2-inch- (13-mm-) wide flanges.
   1. Depth: 1-1/2 inches (38 mm).

E. Furring Channels (Furring Members):
   1. Cold-Rolled Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
   2. Steel Studs and Runners: ASTM C 645.
      a. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm), unless noted otherwise.
      b. Depth: 1-5/8 inches (41 mm) unless noted otherwise.
   3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22 mm) deep.
      a. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).
   4. Resilient Furring Channels: 1/2-inch- (13-mm-) deep members designed to reduce sound transmission.
      a. Configuration: hat shaped.

F. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Armstrong World Industries, Inc.; Drywall Grid Systems.
      b. Chicago Metallic Corporation; Drywall Grid System.
      c. USG Corporation; Drywall Suspension System.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.
   1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.
1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C 841 that apply to framing installation.
2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C 844 that apply to framing installation.
4. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
1. Single-Layer Application: 16 inches (406 mm) o.c. unless otherwise indicated.
2. Multilayer Application: 16 inches (406 mm) o.c. unless otherwise indicated.
3. Tile Backing Panels: 16 inches (406 mm) o.c. unless otherwise indicated.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
   1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.

   2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
      a. Install two studs at each jamb unless otherwise indicated.
      b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
      c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

   3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
   4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
      a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
   5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
   6. Curved Partitions:
      a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
      b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches (150 mm) o.c.

E. Direct Furring:
   1. Screw to wood framing.
   2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

3.5 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
   1. Hangers: 48 inches (1219 mm) o.c.

2. Carrying Channels (Main Runners): 48 inches (1219 mm) o.c.
3. Furring Channels (Furring Members): 16 inches (406 mm) o.c.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
   a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of unistrut or equivalent devices.
3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not attach hangers to steel roof deck.
6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION

ONLINE CERTIFICATIONS DIRECTORY

Design No. U411
BXUV.U411
Fire Resistance Ratings - ANSI/UL 263

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Design/System/Construction/Assembly Usage Disclaimer

- Authorities Having Jurisdiction should be consulted in all cases as to the particular requirements covering the installation and use of UL Certified products, equipment, system, devices, and materials.
- Authorities Having Jurisdiction should be consulted before construction.
- Fire resistance assemblies and products are developed by the design submitter and have been investigated by UL for compliance with applicable requirements. The published information cannot always address every construction nuance encountered in the field.
- When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.
- Only products which bear UL's Mark are considered Certified.

BXUV - Fire Resistance Ratings - ANSI/UL 263

BXUV7 - Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

See General Information for Fire-resistance Ratings - ANSI/UL 263

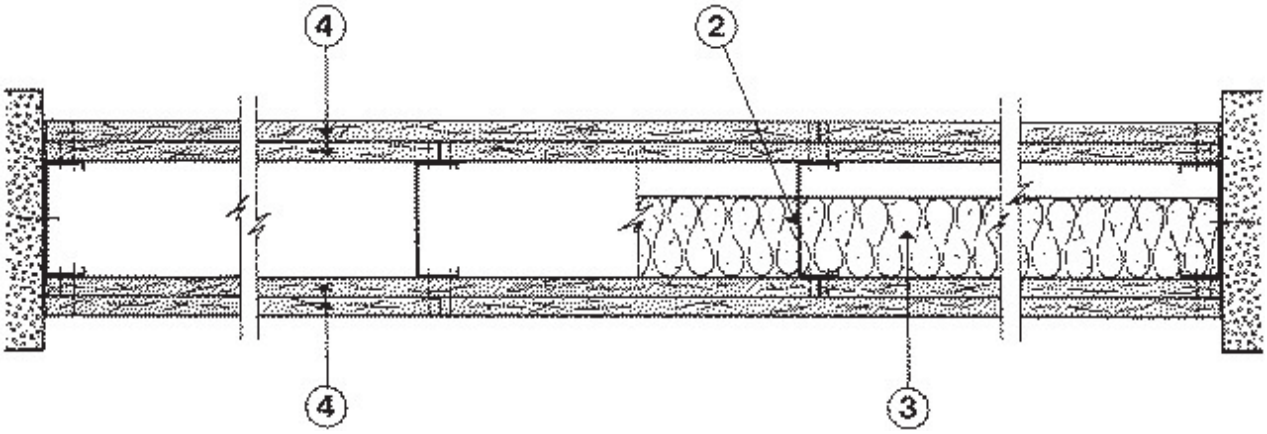
See General Information for Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

Design No. U411

February 25, 2015

Nonbearing Wall Rating — 2 HR.

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**



1. **Floor and Ceiling Runner —** (Not Shown) — Min. 25 MSG galv steel, 1 in. return legs, 2-1/2 in. deep (min), attached to floor and ceiling with fasteners 24 in. OC max.

1A. **Framing Members*— Floor and Ceiling Runners —** (Not shown) — As an alternate to Item 1 - For use with Item 2A, channel shaped, min 2-1/2 in. deep, attached to floor and ceiling with fasteners 24 in. OC. max.

ALLSTEEL & GYPSUM PRODUCTS INC — Type SUPREME Framing System

CALIFORNIA EXPANDED METAL PRODUCTS CO — Viper20™ Track

CONSOLIDATED FABRICATORS CORP, BUILDING PRODUCTS DIV — Type SUPREME Framing System

MARINO/WARE, DIV OF WARE INDUSTRIES INC — Viper20™ Track

PHILLIPS MFG CO L L C — Viper20™ Track

QUAIL RUN BUILDING MATERIALS INC — Type SUPREME Framing System

SCAFCO STEEL STUD MANUFACTURING CO — Type SUPREME Framing System

STEEL CONSTRUCTION SYSTEMS INC — Type SUPREME Framing System

UNITED METAL PRODUCTS INC — Type SUPREME Framing System

1B. **Floor and Ceiling Runners —** (Not shown)—For use with Item 2B- Channel shaped, fabricated from min 20 MSG corrosion-protected or galv steel, min width to accommodate stud size, with min 1 in. long legs, attached to floor and ceiling with fasteners spaced max 24 in. OC.

1C. **Framing Members*— Floor and Ceiling Runners —** (Not shown) — As an alternate to Item 1 - For use with Item 2C, channel shaped, min 2-1/2 in. wide fabricated from min 0.015 in. thick galv steel, attached to floor and ceiling with fasteners 24 in. OC. max.

CLARKDIETRICH BUILDING SYSTEMS — CD ProTRAK

DMFCWBS L L C — ProTRAK

MBA METAL FRAMING — ProTRAK

RAM SALES L L C — Ram ProTRAK

STEEL STRUCTURAL SYSTEMS L L C — Tri-S ProTRAK

1D. **Framing Members*— Floor and Ceiling Runners —** (Not shown) — As an alternate to Item 1 - For use with Item 2D, channel shaped, min 2-1/2 in. wide fabricated from min 0.018 in. thick galv steel, attached to floor and ceiling with fasteners 24 in. OC. max.

TELLING INDUSTRIES L L C — TRUE-TRACK™

1E. **Framing Members*— Floor and Ceiling Runners —** (Not shown) — As an alternate to Item 1 - For use with Item 2E, channel shaped, min 2-1/2 in. wide fabricated from min 25 MSG steel, attached to floor and ceiling with fasteners 24 in. OC. max.

KIRII (HONG KONG) LTD — Type KIRII

1F. **Floor and Ceiling Runners —** (Not shown) — Channel shaped, fabricated from min 0.02 in. galv steel, min width to accommodate stud size, with min 1 in. long legs, for use with studs specified below and fabricated from min 0.02 in. galv steel or thicker, attached to floor and ceiling with fasteners spaced max 24 in. OC.

MARINO/WARE, DIV OF WARE INDUSTRIES INC — Viper20™ Track VT100.

1G. **Framing Members*— Floor and Ceiling Runners —** (Not shown) — As an alternate to Item 1 - For use with Item 2G, channel shaped, min 2-1/2 in. deep, attached to floor and ceiling with fasteners 24 in. OC. max.

TELLING INDUSTRIES L L C — Viper20™ Track

2. **Steel Studs —** Min 2-1/2 in. deep, formed of min 25 MSG galv steel max stud spacing 24 in. OC. Studs to be cut 3/4 in. less than assembly height.

2A. **Framing Members*— Steel Studs —** As an alternate to Item 2 - For use with Item 1G, channel shaped studs, min 2-1/2 in. deep, spaced a max of 24 in. OC. Studs to be cut 3/4 in. less than assembly height.

ALLSTEEL & GYPSUM PRODUCTS INC — Type SUPREME Framing System

CALIFORNIA EXPANDED METAL PRODUCTS CO — Viper20™

CONSOLIDATED FABRICATORS CORP, BUILDING PRODUCTS DIV — Type SUPREME Framing System

MARINO/WARE, DIV OF WARE INDUSTRIES INC — Viper20™

PHILLIPS MFG CO L L C — Viper20™

QUAIL RUN BUILDING MATERIALS INC — Type SUPREME Framing System

SCAFCO STEEL STUD MANUFACTURING CO — Type SUPREME Framing System

STEEL CONSTRUCTION SYSTEMS INC — Type SUPREME Framing System

UNITED METAL PRODUCTS INC — Type SUPREME Framing System

2B. **Steel Studs —** (As an alternate to Item 2, For use with Item 4D) Channel shaped, fabricated from min 20 MSG corrosion-protected or galv steel, 3-1/2 in. min depth, spaced a max of 16 in. OC. Studs friction-fit into floor and ceiling runners. Studs to be cut 5/8 to 3/4 in. less than assembly height.

2C. **Framing Members*— Steel Studs —** As an alternate to Item 2 - For use with Item 1C, channel shaped studs, min 2-1/2 in. wide fabricated from min 0.015 in. thick galv steel, spaced a max of 24 in. OC. Studs to be cut 3/4 in. less than assembly height.

CLARKDIETRICH BUILDING SYSTEMS — CD ProSTUD

DMFCWBS L L C — ProSTUD

MBA METAL FRAMING — ProSTUD

RAM SALES L L C — Ram ProSTUD

STEEL STRUCTURAL SYSTEMS L L C — Tri-S ProSTUD

2D. **Framing Members*— Steel Studs —** As an alternate to Item 2 - For use with Item 1D, channel shaped studs, min 2-1/2 in. wide fabricated from min 0.018 in. thick galv steel, spaced a max of 24 in. OC. Studs to be cut 3/4 in. less than assembly height.

TELLING INDUSTRIES L L C — TRUE-STUD™

2E. **Framing Members*— Steel Studs —** As an alternate to Item 2 - For use with Item 1E, channel shaped studs, min 2-1/2 in. wide fabricated from min 25 MSG steel, spaced a max of 24 in. OC. Studs to be cut 3/4 in. less than assembly height.

KIRII (HONG KONG) LTD — Type KIRII

2F. **Framing Members*— Steel Studs —** As an alternate to Item 2 - For use with Item 1G, channel shaped studs, min 2-1/2 in. deep, spaced a max of 24 in. OC. Studs to be cut 3/4 in. less than assembly height.

TELLING INDUSTRIES L L C — Viper20™

2G. **Framing Members*— Steel Studs —** As an alternate to Item 2 - For use with Item 1, channel shaped studs, Min 2-1/2 in. deep, formed of min 25 MSG galv steel max stud spacing 24 in. OC. Studs to be cut 3/4 in. less than assembly height.

EB MéTAL INC — EB Stud

2H. **Framing Members*— Steel Studs —** As an alternate to Item 2 - For use with Item 1, channel shaped studs, Min 2-1/2 in. deep, formed of min 25 MSG galv steel max stud spacing 24 in. OC. Studs to be cut 3/4 in. less than assembly height.

OLMAR SUPPLY INC — PRIMESTUD

3. **Batts and Blankets* —** (Optional) — Mineral wool or glass fiber batts partially or completely filling stud cavity.

See **Batts and Blankets** (BZJZ) category for names of manufacturers.

3A. **Fiber, Sprayed* —** As an alternate to Batts and Blankets (Item 3) — (100% Borate Formulation) — Spray applied cellulose material. The fiber is applied with water to completely fill the enclosed cavity in accordance with the application instructions supplied with the product with a nominal dry density of 2.7 lb/ft^3. Alternate Application Method: The fiber is applied without water or adhesive at a nominal dry density of 3.5 lb/ft^3, in accordance with the application instructions supplied with the product.

U S GREENFIBER L L C — INS735 & INS745 for use with wet or dry application. INS765LD and INS770LD are to be used for dry application only.

3B. **Fiber, Sprayed* —** As an alternate to Batts and Blankets (Item 3) and Item 3A - Spray applied cellulose insulation material. The fiber is applied with water to interior surfaces in accordance with the application instructions supplied with the product. Applied to completely fill the enclosed cavity. Minimum dry density of 4.3 pounds per cubic ft.

NU-WOOL CO INC — Cellulose Insulation

3C. **Fiber, Sprayed* —** As an alternate to Batts and Blankets (Item 3) - Spray applied cellulose fiber. The fiber is applied with water to completely fill the enclosed cavity in accordance with the application instructions supplied with the product. The minimum dry density shall be 4.30 lbs/ft^3.

INTERNATIONAL CELLULOSE CORP — Celbar-RL

4. **Gypsum Board* —** 5/8 in. thick, outer layer paper, glass mat or vinyl surfaced. (Laminated System) Gypsum board applied vertically in two layers. Inner layer attached to studs with 1 in. long Type S steel screws spaced 8 in. OC along vertical edges, and 12 in. OC in the field and outer layer laminated to inner layer with joint compound, applied with a notched spreader producing continuous beads of compound about 3/8 in. in diameter, spaced not greater than 2 in. OC. Joints of laminated outer layer offset 12 in. from inner layer joints Outer layer gypsum board attached to floor and ceiling runner track with 1-5/8 in. long Type S steel screws spaced 12 in. OC.

Optional, (Direct Attached System), Inner layer attached to studs with 1 in. long Type S steel screws spaced 16 in. OC in the field and along the vertical edges. Outer layer attached to the studs over the inner layer with 1-5/8 in. long Type S steel screws spaced 16 in. OC in the field and along the vertical edges and 12 in. OC to the floor and ceiling runners. Joints of screw-attached outer layer offset from inner layer joints. Joints of outer layer may be taped or untaped.

Nom 3/32 in. thick gypsum veneer plaster may be applied to the entire surface of Classified veneer baseboard. Joints reinforced.

ACADIA DRYWALL SUPPLIES LTD — Type X, 5/8 Type X, Type Blueglass Exterior Sheathing

AMERICAN GYPSUM CO — Types AG-C, AGX-1, M-Glass, AGX-11.

BEIJING NEW BUILDING MATERIALS PUBLIC LTD CO — Type DBX-1.

CERTAINTEED GYPSUM INC — Types 1, FRPC, EGRG, GlasRoc, Type X or Type C, 5/8" Easi-Lite Type X.

CGC INC — Type AR, C, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, WRC or WRX.

CONTINENTAL BUILDING PRODUCTS OPERATING CO, L L C — Types LGFC2A, LGFC6A, LGFC-C/A, LGFC-WD, LGLLX.

GEORGIA-PACIFIC GYPSUM L L C — Types 5, 6, 9, C, DAP, DD, DA, DAPC, DGG, DS, GPFS6, LS, TG-C, Type X, Veneer Plaster Base-Type X, Water Rated-Type X, Sheathing Type-X, Soffit-Type X, GreenGlass Type X, Type X ComfortGuard Sound Deadening Gypsum Board, Type LWX, Veneer Plaster Base-Type LWX, Water Rated-Type LWX, Sheathing Type-LWX, Soffit-Type LWX, Type DGLW, Water Rated-Type DGLW, Sheathing Type- DGLW, Soffit-Type DGLW, Type LW2X, Veneer Plaster Base - Type LW2X, Water Rated - Type LW2X, Sheathing - Type LW2X, Soffit - Type LW2X, Type DGL2W, Water Rated - Type DGL2W, Sheathing - Type DGL2W.

NATIONAL GYPSUM CO — Types eXP-C, FSK, FSK-C, FSW, FSW-3, FSW-5, FSW-6, FSW-8, FSW-C, FSW-G, FSMR-C, FSL, SoundBreak XP Type X Gypsum Board.

PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type C, PG-3, PG-5, PG-9, PG-11, PG-C, PGS-WRS.

PANEL REY S A — Types GREX, PRX, RHX, MDX, ETX or PRC.

SIAM GYPSUM INDUSTRY (SARABURI) CO LTD — Type EX-1

THAI GYPSUM PRODUCTS PCL — Type C or Type X

UNITED STATES GYPSUM CO — Type AR, C, FRX-G, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SGX, SHX, WRC, WRX, USGX.

USG MEXICO S A DE C V — Type AR, C, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, WRC or WRX.

4A. **Gypsum Board* —** (As an alternate to Item 4) — Nom 3/4 in. thick, installed as described in Item 4 with 1-1/4 in. long Type S screws for inner layer and 2-1/4 in. long Type S screws for outer layer.

CGC INC — Types AR, IP-AR.

UNITED STATES GYPSUM CO — Types AR, IP-AR.

USG MEXICO S A DE C V — Types AR, IP-AR.

4B. **Gypsum Board* —** (As an alternate to Item 4 and 4A) —5/8 in. thick, 24 to 54 in. wide, applied horizontally as the outer layer to one side of the assembly. Horizontal joints need not be backed by steel framing. Secured as described in Item 4 for the direct attached system. When used in widths other than 48 in., gypsum panels to be installed horizontally.

CERTAINTEED GYPSUM INC — Type X, Type C.

CGC INC — Type SHX.

THAI GYPSUM PRODUCTS PCL — Type X, Type C.

UNITED STATES GYPSUM CO — Type SHX, FRX-G.

USG MEXICO S A DE C V — Type SHX.

4C. **Gypsum Board* —** (As an alternate to Items 4, 4A and 4B) — Two layers of 5/8 in. thick gypsum board applied horizontally or vertically. Inner layer attached to studs with No. 6 by 1 in. long Type S bugle head screws spaced 24 in. OC along the top and bottom tracks starting 2 in. and then 12 in. from the vertical edge. Inner layer screws spaced 24 in. OC along the studs, starting 2 in. and then 12 in. from the top and bottom of the studs and starting 1-1/4 in. from the horizontal joints when installed horizontally. Outer layer attached to studs with 1-5/8 in. long Type S bugle head screws spaced 16 in. OC along the top and bottom tracks starting 1-3/4 in. from the vertical edge. Outer layer screws spaced 16 in. OC along the studs, starting 1-3/4 in. and then 8 in. from the top and bottom of the studs and starting 1-

1/4 in. and then 8 in. from the horizontal joints when installed horizontally. Vertical joints centered over studs and staggered one stud cavity on opposite sides of studs. Vertical joints in adjacent layers staggered one stud cavity. Horizontal joints need not be backed by steel framing. Horizontal edge joints and horizontal butt joints on opposite sides of studs need not be staggered. Horizontal edge joints and horizontal butt joints in adjacent layers staggered a min of 12 in. When outer layers are installed horizontally, vinyl or casein, dry or premixed joint compound shall be applied in two coats to joints and screw heads of outer layer. Paper tape, nom 2 in. wide, embedded in first layer of compound over all joints of outer layer panels. Nom 3/32 in. thick gypsum veneer plaster may be applied to the entire surface of Classified veneer baseboard. Joints reinforced.

GEORGIA-PACIFIC GYPSUM L L C — Types 5, 6, 9, C, DAP, DD, DA, DAPC, DGG, DS, GPFS6, LS, TG-C, Type X, Veneer Plaster Base-Type X, Water Rated-Type X, Sheathing Type-X, Soffit-Type X, GreenGlass Type X, Type X ComfortGuard Sound Deadening Gypsum Board, Type LWX, Veneer Plaster Base-Type LWX, Water Rated-Type LWX, Sheathing Type-LWX, Soffit-Type LWX, Type DGLW, Water Rated-Type DGLW, Sheathing Type- DGLW, Soffit-Type DGLW, Type LW2X, Veneer Plaster Base - Type LW2X, Water Rated - Type LW2X, Sheathing - Type LW2X, Soffit - Type LW2X, Type DGL2W, Water Rated - Type DGL2W, Sheathing - Type DGL2W.

4D. **Gypsum Board* —** (Not Shown) - (As an alternate to Item 4 when used as the base layer on one or both sides of wall. For direct attachment only to steel studs Item 2B) - Nom 5/8 in. thick lead backed gypsum panels with beveled, square or tapered edges, applied vertically. Vertical joints centered over studs and staggered min 1 stud cavity on opposite sides of studs. Gypsum board secured to studs with 1-1/4 in. long Type S-12 steel screws spaced 8 in. OC at perimeter and 12 in. OC in the field.

RAY-BAR ENGINEERING CORP — Type RB-LBG

4E. **Gypsum Board* —** (As an alternate to Items 4 through 4D) — Nominal 5/8 in. thick, 4 ft wide panels, applied vertically and secured as described in Item 4.

PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Types QuietRock ES.

4F. **Gypsum Board* —** (As an alternate to Items 4 through 4E) - 5/8 in. thick, 4 ft. wide, paper surfaced, applied vertically and secured as described in Item 4.

CERTAINTEED GYPSUM INC — Type SilentFX

4G. **Gypsum Board* —** As an alternate to Item 4- Nom. 5/8 in. thick, inner layer attached vertically to studs with 1 in. long Type S steel screws spaced 16 in. OC in the field and along the vertical edges. Outer layer attached to the studs horizontally over the inner layer with 1-5/8 in. long Type S steel screws spaced 16 in. OC in the field and along the vertical edges and 12 in. OC to the floor and ceiling runners. Joints of outer layer must be taped. Nom 3/32 in. thick gypsum veneer plaster may be applied to the entire surface of Classified veneer baseboard.

ACADIA DRYWALL SUPPLIES LTD — Type Blueglass Exterior Sheathing

PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Types C, PG-11, PGS-WRS.

4H. **Gypsum Board* —** (Not Shown) - (As an alternate to Items 4) For Direct Application to Studs Only- For use as the base layer on one or both sides of the wall. Nom 5/8 in. thick lead backed gypsum panels with beveled, square or tapered edges, applied vertically. Vertical joints centered over studs and staggered min 1 stud cavity on opposite sides of studs. Wallboard secured to studs with 1-5/8 in. long Type S 12 steel screws spaced 8 in. OC at perimeter and 12 in OC in the field. Lead batten strips required behind vertical joints of lead backed gypsum wallboard and optional at remaining stud locations. Fasteners for face layer gypsum panels when installed over lead backed board to be min 2-1/2 in. Type S-12 bugle head steel screws spaced as described in Item 4. To be used with Lead Batten Strips (see Item 5A) or Lead Discs (see Item 6A).

MAYCO INDUSTRIES INC — Type X-Ray Shielded Gypsum

4I. **Gypsum Board* —** (As an alternate to Item 4, not for use with Items 1C and 2C) - Nom. 5/8 in. thick gypsum panels with beveled, square or tapered edges installed as described in Item 4.

CGC INC — Type ULX

UNITED STATES GYPSUM CO — Type ULX.

USG MEXICO S A DE C V — Type ULX

4J. **Gypsum Board* —** (As an alternate to Item 4 when used as the base layer on one or both sides of wall. For direct attachment only to steel studs Item 2B). Nom 5/8 in. thick lead backed gypsum panels with beveled, square or tapered edges, applied vertically. Vertical joints centered over studs and staggered min 1 stud cavity on opposite sides of studs.

Wallboard secured to studs with 1-1/4 in. long Type S-12 steel screws gypsum panel steel screws spaced 8 in. OC at perimeter and 12 in. OC in the field. Lead batten strips required behind vertical joints of lead backed gypsum wallboard and optional at remaining stud locations. Lead batten strips, min 2 in. wide, max 8 ft long with a max thickness of 0.14 in. placed on the face of studs and attached to the stud with construction adhesive and two 1 in. long Type S-12 pan head steel screws, one at the top of the strip and one at the bottom of the strip. Lead discs, nominal 3/8 in. diam by max 0.085 in. thick. Compression fitted or adhered over the screw heads. Lead batten strips and discs to have a purity of 99.9% meeting the Federal specification QQ-L-201f, Grade "C".

RADIATION PROTECTION PRODUCTS INC — Type RPP - Lead Lined Drywall

4K. **Gypsum Board —** (As an alternate to Items 4 through 4J, not for use with Items 1C and 2C). Two layers of nominal 15 mm thick gypsum board applied vertically. Inner layer attached to studs with No. 3.5 x 1-3/8 in. long bugle head, self-drilling screws spaced 23-5/8 in. OC in the field and 15-3/4 in. OC in the perimeter, with the first screw 2 in. from the edge. Outer layer attached to the studs over the inner layer with No. 3.5 x 1-3/4 in. long bugle head, self-drilling screws spaced 11-13/16 in. OC in the field and 7-7/8 in. OC in the perimeter, with the first screw 3/4 in. from the edge. Outer layer screws staggered from inner layer screws. Vertical joints centered over studs and staggered one stud cavity on opposite sides of studs. Vertical joints in adjacent layer staggered one stud cavity. Self-adhesive fiberglass mesh (9x9 mesh) tape, nom 2 in. wide, applied over all joints of outer layer panels. Dry or premixed joint compound applied in two coats to joints over the mesh tape and screw heads of outer layer.

GYPSEMNA CO LLC — Types MRFW, FW, TF.

4L. **Gypsum Board* —** (As an alternate to Items 4 through 4K) - Two layers of 5/8 in. thick gypsum board applied vertically or horizontally. Inner layer attached to studs with #6 x 1 in. long bugle head screws spaced 12 in. OC along the top and bottom tracks and 16 in. OC in the field and along the vertical edges. Outer layer attached to studs with #6 x 1-5/8 in. long bugle head screws spaced 12 in. OC along the top and bottom tracks and 16 in. OC in the field and along the vertical edges. Vertical joints are centered over studs and staggered between layers and on opposite sides of the wall. Horizontal joints on the face layer are staggered 12 in. from the base layer. Horizontal joints need not to be backed by steel framing.

CONTINENTAL BUILDING PRODUCTS OPERATING CO, L L C — Type LGFC6A, LGFC-C/A.

4M. **Wall and Partition Facings and Accessories* —** (As an alternate to Items 4 through 4L) — Nominal 5/8 in. thick, 4 ft wide panels, applied vertically and secured as described in Item 4.

PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type QuietRock 527.

4N. **Gypsum Board* —** (As an alternate to Item 4 through 4M) - For direct application to studs only - Four layers nom. 5/16 in. thick gypsum panels applied vertically or horizontally. When applied horizontally, base layer secured to studs with 1 in. Type S screws spaced 24 in. OC. Second layer installed with joints offset 12 in. from base layer and secured with 1 in. Type S screws spaced 24 in. OC. Third layer installed with joints in line with base layer and secured with 1-1/2 in. Type S screws spaced 16 in. OC. Fourth layer installed with joints in line with second layer and secured with 1-5/8 in. Type S screws spaced 12 in. OC. For all layers, screws offset 4 in. from previous layer. When applied vertically, base layer secured with 1 in. Type S screws spaced 24 in. OC. Second layer secured with joints offset one stud cavity and secured with 1 in. Type S screws spaced 24 in. OC. Third layer installed with joints in line with base layer and secured with 1-1/2 in. Type S screws spaced 12 in. OC. Fourth layer secured with joints in line with second layer and secured with 1-5/8 in. Type S screws spaced 8 in. OC along vertical edges and 12 in. OC in the field. For all layers, screws offset 4 in. from previous layer.

NATIONAL GYPSUM CO — Type FSW

5. **Lead Batten Strips —** (Not Shown, For Use With Item 4D) - Lead batten strips, min 1-1/2 in. wide, max 10 ft long with a max thickness of 0.125 in. Strips placed on the interior face of studs and attached from the exterior face of the stud with two 1 in. long Type S-12 pan head steel screws, one at the top of the strip and one at the bottom of the strip. Lead batten strips to have a purity of 99.9% meeting the Federal specification QQ-L-201f, Grade "C". Lead batten strips required behind vertical joints of lead backed gypsum board (Item 4D) and optional at remaining stud locations. Required behind vertical joints.

5A. **Lead Batten Strips —** (Not Shown, for use with Item 4H) Lead batten strips, 2 in. wide, max 10 ft long with a max thickness of0.140 in. Strips placed on the face of studs and attached to the stud with two min. 1 in. long min. Type S-8 pan head steel screws, one at the top of the strip and one at the bottom of the strip or with one min. 1 in. long min. Type S-8 pan head steel screw at the top of the strip. Lead batten strips to have a purity of 99.5% meeting the Federal specification QQ-L-201f, Grades "B, C or D". Lead batten strips required behind vertical joints of lead backed gypsum wallboard (Item 6) and optional at remaining stud locations.

6. **Lead Discs or Tabs —** (Not Shown, For Use With Item 4D) - Used in lieu of or in addition to the lead batten strips (Item 5) or optional at other locations - Max 3/4 in. diam by max 0.125 in. thick lead discs compression fitted or adhered over steel screw heads or max 1/2 in. by 1-1/4 in. by max 0.125 in. thick lead tabs placed on gypsum boards (Item 4D) underneath screw locations prior to the installation of the screws. Lead discs or tabs to have a purity of 99.9% meeting the Federal specification QQ-L-201f, Grade "C".

6A. **Lead Discs —** (Not Shown, for use with Item 4H) Max 5/16 in. diam by max0.140 in. thick lead discs compression fitted or adhered over steel screw heads. Lead discs to have a purity of 99.5% meeting the Federal Specification QQ-L-201f, Grades "B, C or D".

7. **Mineral and Fiber Board* —** (Optional, Not shown) — For optional use as an additional layer on one side of wall. Nom 1/2 in. thick, 4 ft wide with long dimension parallel and centered over studs. Attached to studs and floor and ceiling runners with 1-5/8 in. long Type S steel screws, spaced 12 in. OC. The required UL Classified gypsum board layer(s) is/are to be installed as indicated as to fastener type and spacing, except that the required fastener length shall be increased by a minimum of 1/2 in. Not evaluated or intended as a substitute for the required layer(s) of UL Classified Gypsum Board.

HOMASOTE CO — Homasote Type 440-32

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Last Updated on 2015-02-25

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Design No. U415
BXUV.U415
Fire Resistance Ratings - ANSI/UL 263

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See General Information for Fire-resistance Ratings - ANSI/UL 263

See General Information for Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

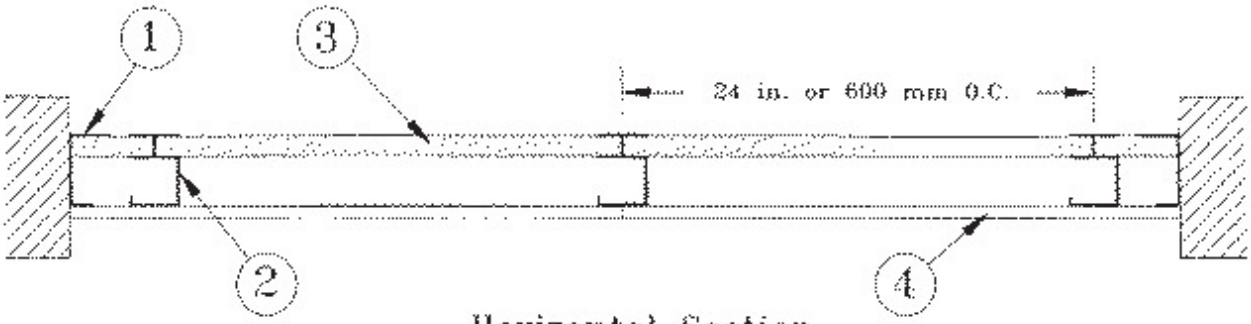
Design No. U415

March 16, 2015

Nonbearing Wall Ratings — 1, 2, 3 or 4 Hr

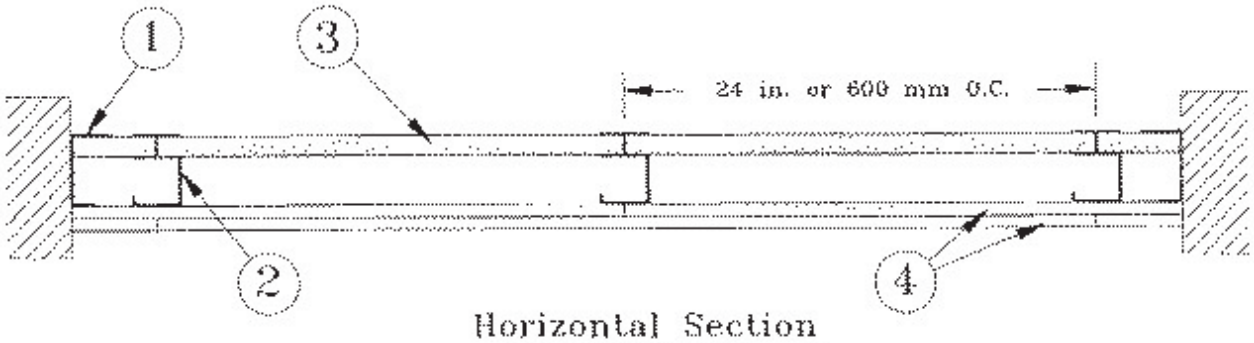
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System A — 1 Hr.



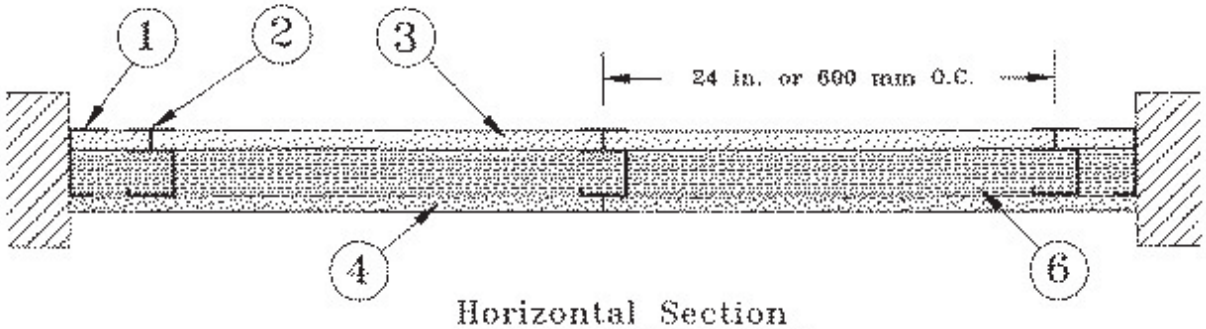
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System B – 2 Hr.



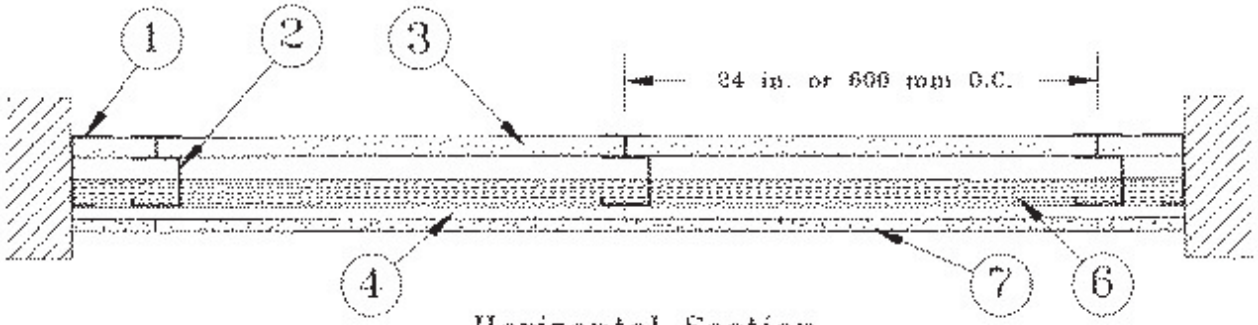
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System C – 2 Hr.



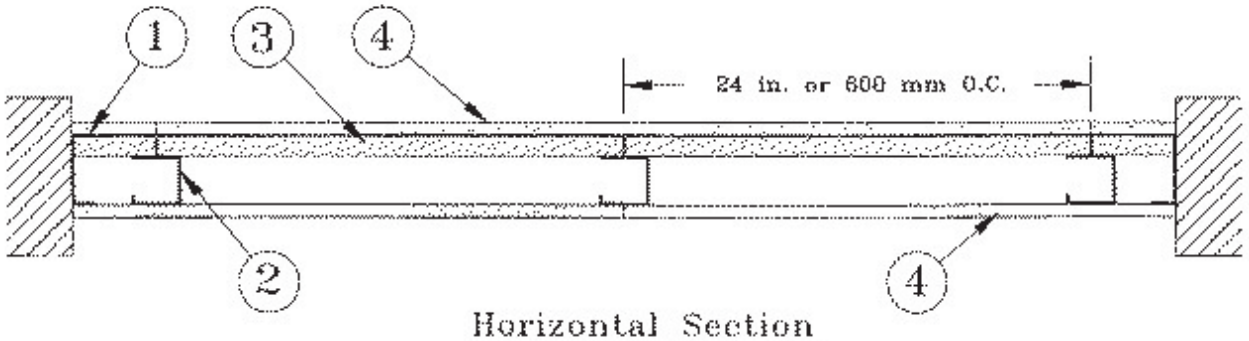
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System D – 2 Hr.



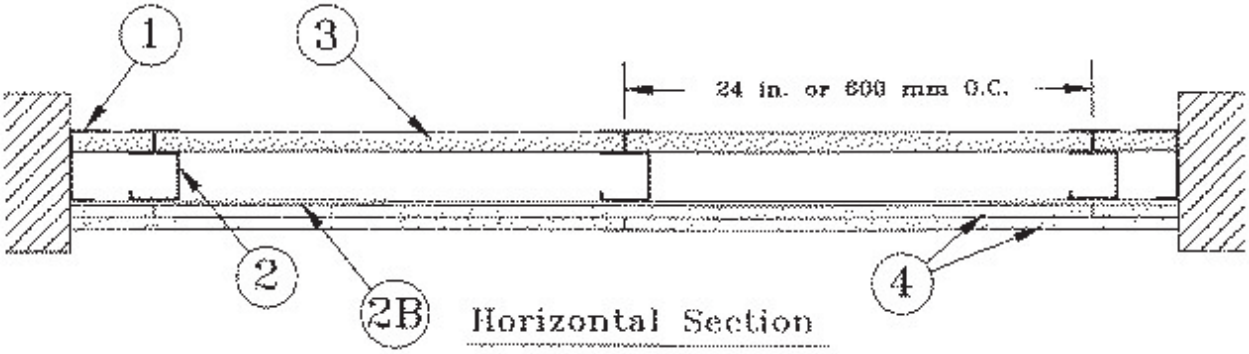
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System E – 2 Hr.



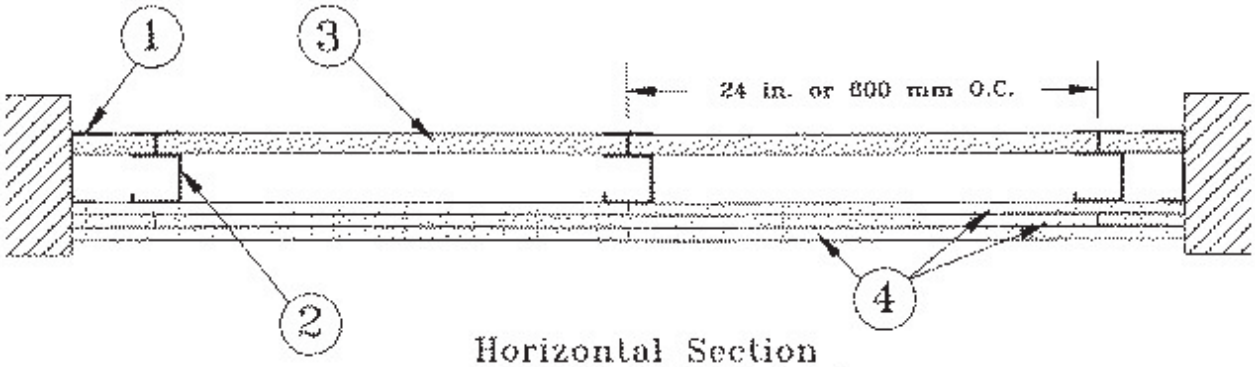
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System F – 2 Hr.



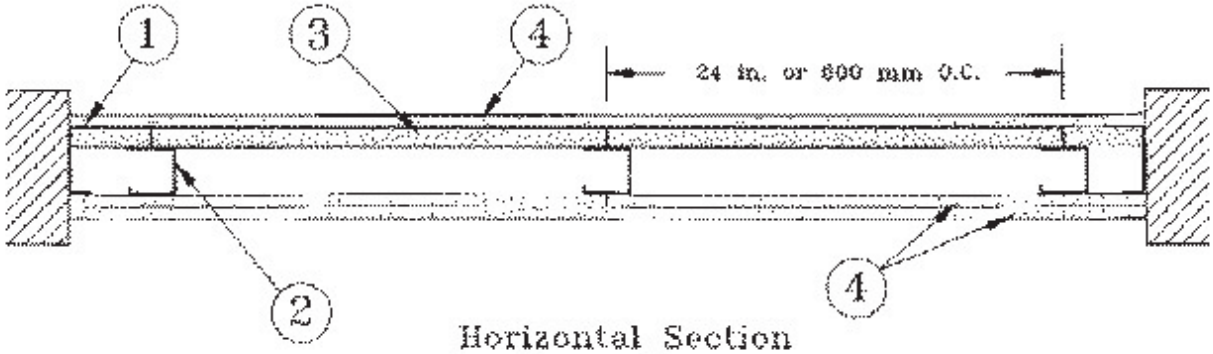
Horizontal Section

System G – 3 Hr.



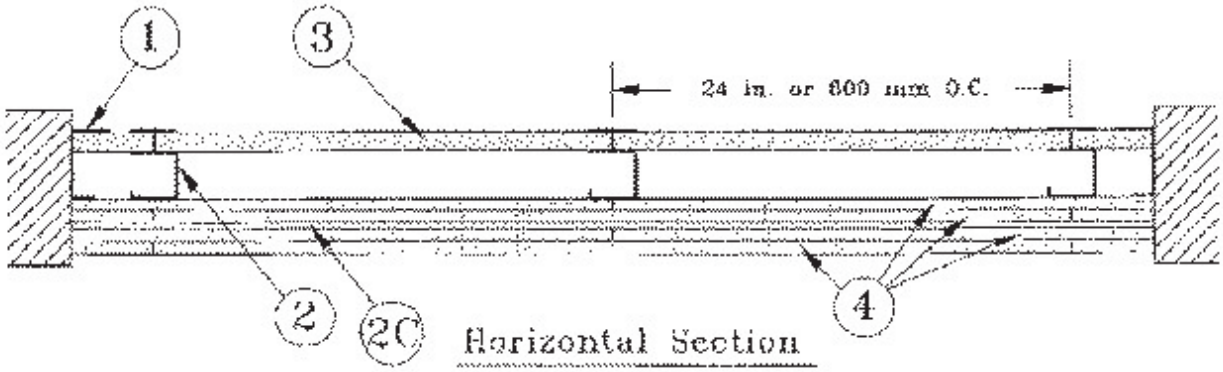
Horizontal Section

System H – 3 Hr.



Horizontal Section

System I – 4 Hr.



Horizontal Section

1. **Floor, Side and Ceiling Runners —** "J" - shaped runner, min 2-1/2 in. deep (min 4 in. deep when System C is used), with unequal legs of 1 in. and 2 in., fabricated from min 24 MSG (min 20 MSG when Item 4A, 4B or 7 are used) galv steel. Runners positioned with short leg toward finished side of wall. Runners attached to structural supports with

steel fasteners located not greater than 2 in. from ends and not greater than 24 in. OC. "E" - shaped studs (Item 2A) may be used as side runners in place of "J" - shaped runners.

2. **Steel Studs —** "C-H" - shaped studs, min 2-1/2 in. deep (min 4 in. deep when System C is used), fabricated from min 25 MSG (min 20 MSG when Items 2D, 4A, 4B or 7 is used) galv steel. Cut to lengths 3/8 to 1/2 in. less than floor-to-ceiling height and spaced 24 in. or 600 mm OC.

2A. **Steel Studs —** (Not Shown) — "E" - shaped studs installed back to back in place of "C-H" - shaped studs (Item 2) "E" - shaped studs secured together with steel screws spaced a maximum 12 in. OC. Fabricated from min 25 MSG (min 20 MSG when Item 2D, 4A, 4B or 7 is used) galv steel, min 2-1/2 in. deep (min 4 in. deep when System C is used), with one leg 1 in. long and two legs 3/4 in. long. Shorter legs 1 in. apart to engage gypsum liner panels. Cut to lengths 3/8 to 1/2 in. less than floor to ceiling heights.

2B. **Furring Channels —** (Optional, not shown) — For use with single or double layer systems. Resilient furring channels fabricated from min 25MSG corrosion protected steel, installed horizontally, and spaced vertically a max 24 in. OC. Flange portion of channel attached to each intersecting "C-H" or "E" stud on side of stud opposite the 1 in. liner panels with 1/2 in. long Type S or S-12 pan-head steel screws. When furring channels are used, wallboard to be installed vertically only. Not to be used with Type FRX-G gypsum wallboard, Type RB-LBG (Item 4A), Type Nelco (Item 4B) or cementitious backer units (Item 7).

2C. **Furring Channels —** For use with System I - "Hat" - shaped, 25 MSG galv steel furring channels attached directly over the inner layers of wallboard to each stud with 2 in. long Type S pan head steel screws. Screws alternate from top flange to bottom flange at each stud intersection. Furring channels spaced vertically max 24 in. OC.

2D. **Steel Framing Members* —** (Optional, not shown) — For use with single or double layer systems. Furring channels and Steel Framing Members as described below. Not to be used with Type FRX-G gypsum wallboard, Type RB-LBG (Item 4A), Type Nelco (Item 4B) or cementitious backer units (Item 7):

a. **Furring Channels —** Formed of No. 25 MSG galv steel. 2-9/16 in. or 2-23/32 in. wide by 7/8 in. deep, spaced max. 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Gypsum board installed vertically only and attached to furring channels as described in Item 3.

b. **Steel Framing Members* —** Used to attach furring channels (Item 2Da) to studs (Item 2 or 2A). Clips spaced max. 24 in. OC., and secured to studs with No. 8 x 1-1/2 in. minimum self-drilling, S-12 steel screw through the center grommet. Furring channels are friction fitted into clips. RSIC-1 clip for use with 2-9/16 in. wide furring channels. RSIC-1 (2.75) clip for use with 2-23/32 in. wide furring channels.

PAC INTERNATIONAL INC — Types RSIC-1, RSIC-1 (2.75)

2E. **Steel Framing Members —** (Optional, Not Shown)* - Furring channels and resilient sound isolation clip as described below:

a. **Furring Channels —** Formed of No. 25 MSG galv steel. Spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels overlapped 6 in. and secured together with four self-tapping No. 8x1/2 Self Drilling screws (2 per side 1 in. and 4 in. from overlap edge). Gypsum board attached to furring channels as described in Item 3. Side joint furring channels shall be attached to studs with RESILMOUNT Sound Isolation Clips - Type A237R located approximately 2 in. from each end of length of channel. Both Gypsum Boards at side joints fastened into channel with screws spaced 8 in. OC, approximately 1/2 in. from joint edge.

b. **Steel Framing Members* —** Resilient sound isolation clip used to attach furring channels (Item 2Ea) to studs. Clips spaced 24 in. OC., and secured to studs with No. 10 x 2-1/2 in. coarse drywall screw through the center hole. Furring channels are friction fitted into clips.

STUDCO BUILDING SYSTEMS — RESILMOUNT Sound Isolation Clips - Type A237R

2F. **Steel Framing Members* —** (Optional, not shown) — For use with single or double layer systems. Furring channels and Steel Framing Members as described below. Not to be used with Type FRX-G gypsum wallboard, Type RB-LBG (Item 4A), Type Nelco (Item 4B) or cementitious backer units (Item 7):

a. **Furring Channels —** Formed of No. 25 MSG galv steel. 2-3/8 in. wide by 7/8 in. deep, spaced max. 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Gypsum board installed vertically only and attached to furring channels as described in Item 3.

b. **Steel Framing Members* —** Used to attach furring channels (Item 2Da) to studs (Item 2 or 2A). Clips spaced max. 24 in. OC. GENIECLIPS secured to studs with No. 8 x 1-1/2 in. minimum self-drilling, S-12 steel screw through the center grommet. Furring channels are friction fitted into clips.

PLITEQ INC — Type GENIECLIP

3. **Gypsum Board* —** Gypsum liner panels, nom 1 in. thick, 24 in. or 600 mm (for metric spacing) wide. Panels cut 1 in. less in length than floor to ceiling height. Vertical edges inserted in "H" portion of "C-H" studs or the gap between the two 3/4 in. legs of the "E" studs. Free edge of end panels attached to long leg of vertical "J" - runners with 1-5/8 in. long Type S steel screws spaced not greater than 12 in. OC. When wall height exceeds liner panel length, liner panel may be butted to extend to the full height of the wall. Horizontal joints need not be backed by steel framing. In

System I, butt joints in liner panels are staggered min 36 in. Butt joints backed with 6 in. by 22 in. strips of 3/4 in. thick gypsum wallboard (Item 4). Wallboard strips centered over butt joints and secured to liner panels with six 1-1/2 in. long Type G steel screws, three screws along the 22 in. dimension at the top and bottom of the strips.

CGC INC — Type SLX

UNITED STATES GYPSUM CO — Type SLX

USG MEXICO S A DE C V — Type SLX

4. **Gypsum Board* —**

System A — 1 Hr

Gypsum panels, with beveled, square or tapered edges, nom 5/8 in. thick, 48 in. or 1200 mm wide, applied vertically or horizontally, attached to studs with 1 in. long Type S steel screws spaced 12 in. when installed vertically or 8 in OC when installed horizontally. Horizontal joints need not be backed by steel framing.

CGC INC — Types AR, C, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, ULX, WRC, WRX

UNITED STATES GYPSUM CO — Types AR, C, FRX-G, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SGX, SHX, ULX, WRC, WRX, USGX

USG MEXICO S A DE C V — Types AR, C, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, ULX, WRC, WRX

System B — 2 Hr

Gypsum panels, with beveled, square or tapered edges, nom 1/2 in. or 5/8 in. thick, 48 in. or 1200 mm wide, applied vertically or horizontally in two layers. Inner or base layer attached to studs with 1 in. long Type S steel screws spaced 24 in. OC when installed vertically or 16 in. OC when installed horizontally. Outer or face layer attached to studs with 1-5/8 in. long Type S steel screws spaced 12 in. OC when installed vertically and staggered 12 in. from base layer screws or 8 in. OC when installed horizontally and staggered 8 in. from base layer screws. Horizontal joints between inner and outer layers staggered a min of 12 in. Horizontal joints need not be backed by steel framing. Vertical joints centered over studs and staggered 24 in.

CGC INC — 1/2 in. Type C, IP-X2, IPC-AR or WRC; 5/8 in. Types AR, C, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, ULX, WRC, WRX

UNITED STATES GYPSUM CO — 1/2 in. Types C, IP-X2, IPC-AR, or WRC; 5/8 in. Types AR, C, FRX-G, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SGX, SHX, ULX, USGX, WRC, WRX

USG MEXICO S A DE C V — 1/2 in. Types C, IP-X2, IPC-AR or WRC; 5/8 in. Types AR, C, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, ULX, WRC, WRX

System C — 2 Hr

Gypsum panels, with beveled, square or tapered edges, nom 3/4 in. thick, 48 in. or 1200 mm wide, applied vertically or horizontally, secured with 1-1/4 in. long Type S steel screws spaced 8 in. OC along vertical edges and 12 in. OC in the field when installed vertically or 8 in. OC along the vertical edges and in the field when installed horizontally. Horizontal joints need not be backed by steel framing. Screws along side joints offset 4 in. Requires min 4 in. deep framing per Items 1, 2 and 3. Requires min 3 in. thick mineral wool batts per Item 6.

CGC INC — Types IP-X3 or ULTRACODE

UNITED STATES GYPSUM CO — Types IP-X3 or ULTRACODE

USG MEXICO S A DE C V — Types IP-X3 or ULTRACODE

System D — 2 Hr

Gypsum panels, with beveled, square or tapered edges, nom 5/8 in. thick, 48 in. or 1200 mm wide, applied vertically

or horizontally, attached directly to studs with 1 in. long Type S steel screws spaced 24 in. when installed vertically or 16 in. OC when installed horizontally. . Horizontal joints need not be backed by steel framing. Requires face layer of 1/2 or 5/8 in. thick cementitious backer units per Item 7 and min 1-1/2 in. thick mineral wool batts per Item 6.

CGC INC — Types AR, C, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, ULX, WRC, WRX

UNITED STATES GYPSUM CO — Types AR, C, FRX-G, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SGX, SHX, ULX, USGX, WRC, WRX

USG MEXICO S A DE C V — Types AR, C, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, ULX, WRC, WRX

System E — 2 Hr

Gypsum panels, with beveled, square or tapered edges, nom 1/2 in. or 5/8 in. thick, 48 in. or 1200 mm wide, applied vertically or horizontally, attached to studs with 1 in. long Type S steel screws spaced 12 in. OC when installed vertically or 8 in. when installed horizontally. Horizontal joints need not be backed by steel framing.

CGC INC — 1/2 in. Types C, IP-X2, IPC-AR; 5/8 in. Types AR, C, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, ULX, WRC, WRX

UNITED STATES GYPSUM CO — 1/2 in. Types C, IP-X2, IPC-AR; 5/8 in. Types AR, C, FRX-G, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SGX, SHX, ULX, USGX, WRC, WRX.

USG MEXICO S A DE C V — 1/2 in. Types C, IP-X2, IPC-AR; 5/8 in. Types AR, C, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, ULX, WRC, WRX

System F — 2 Hr

Gypsum panels, with beveled, square or tapered edges, nom 1/2 in. or 5/8 in. thick, 48 in. or 1200 mm wide, applied vertically in two layers. Inner or base layer attached to resilient furring channels (Item 2B) with 1 in. long Type S steel screws spaced 24 in. Outer or face layer attached to resilient furring channels (Item 2B) with 1-5/8 in. long Type S steel screws spaced 12 in. OC and staggered 12 in. from base layer screws. Joints between inner and outer layers staggered 24 in.

CGC INC — 1/2 in. Type C, IP-X2, IPC-AR or WRC; 5/8 in. Types AR, C, FRX-G, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, ULX, WRC, WRX

UNITED STATES GYPSUM CO — 1/2 in. Type C, IP-X2, IPC-AR or WRC; 5/8 in. Types AR, C, FRX-G, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SGX, SHX, ULX, USGX, WRC, WRX

USG MEXICO S A DE C V — 1/2 in. Types C, IP-X2, IPC-AR or WRC; 5/8 in. Types AR, C, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, ULX, WRC, WRX

System G — 3 Hr

Gypsum panels, with beveled, square or tapered edges, nom 5/8 in. thick, 48 in. or 1200 mm wide, applied vertically or horizontally in three layers. Inner or base layer attached to studs with 1 in. long Type S steel screws spaced 24 in. OC when installed vertically or 16 in OC when installed horizontally. Middle layer attached to studs with 1-5/8 in. long Type S steel screws spaced 24 in. when installed vertically or 16 in. OC when installed horizontally. Outer or face layer attached to studs with 2-1/4 in. long Type S steel screws spaced 16 in. when installed vertically or 12 in. OC when installed horizontally. Screws offset 6 in. from layer below. Horizontal joints on adjacent layers staggered a min of 12 in. . Horizontal joints need not be backed by steel framing. Vertical joints centered over studs and staggered 24 in. on adjacent layers.

CGC INC — Types C, IP-X2, IPC-AR, WRC

UNITED STATES GYPSUM CO — Types C, IP-X2, IPC-AR, WRC

USG MEXICO S A DE C V — Types C, IP-X2, IPC-AR, WRC

System H — 3 Hr

Gypsum panels, with beveled, square or tapered edges, nom 5/8 in. thick, 48 in. or 1200 mm wide, applied vertically or horizontally, two layers over the flange of the "C" section of the studs, one layer over the flange of the "H" section of the studs. Inner or base layer attached to studs with 1 in. long Type S steel screws spaced 24 in. OC when installed vertically or 16 in. OC when installed horizontally. Face layer attached to studs with 1-5/8 in. long Type S steel screws spaced 16 in. when installed vertically or 12 in. OC when installed horizontally. Screws offset 6 in. from layer below. Horizontal joints on adjacent layers staggered a min of 12 in. Horizontal joints need not be backed by steel framing. Vertical joints centered over studs and staggered 24 in. on adjacent layers.

CGC INC — Types C, IP-X2, IPC-AR, WRC

UNITED STATES GYPSUM CO — Types C, IP-X2, IPC-AR, WRC

USG MEXICO S A DE C V — Types C, IP-X2, IPC-AR, WRC

System I — 4 Hr

Gypsum panels, with beveled, square or tapered edges, nom 3/4 in. thick, 4 ft wide (or 1200 mm for metric spacing) wallboard with square or tapered edges. Total of four layers to be used. First and second (inner) layers applied vertically or horizontally over the steel studs. Horizontal joints need not be backed by steel framing. When applied vertically, joints centered over studs and staggered min 24 in., otherwise all joints staggered min 12 in. First layer secured to studs with 1-1/4 in. long Type S self-drilling, self-tapping bugle-head steel screws spaced 24 in. OC. Second layer secured to studs with 2-1/4 in. long Type S self-drilling, self-tapping bugle-head steel screws spaced 12 in. OC. Third layer applied vertically over the furring channels (Item 2C) with a 1-1/4 in. long Type S self-drilling, self-tapping bugle-head steel screws spaced 12 in. OC. Fourth layer applied vertically or horizontally with 2-1/4 in. long Type S self-drilling, self-tapping bugle-head steel screws spaced 12 in. OC. When applied vertically, joints to be staggered min 24 in. from third layer, otherwise all joints staggered min 12 in.

CGC INC — Types IP-X3 or ULTRACODE

UNITED STATES GYPSUM CO — Types IP-X3 or ULTRACODE

USG MEXICO S A DE C V — Types IP-X3 or ULTRACODE

4A. **Gypsum Board* —** (As an alternate to Item 4 Systems A, B, C, D, E, G, H, and I when used as the base layer, For direct attachment only) - Nom 5/8 in. or ¾ in. thick lead backed gypsum panels with beveled, square or tapered edges, applied vertically. Vertical joints centered over 20 MSG steel studs and staggered min 1 stud cavity on opposite sides of studs. See Items 1, 2, 2A, 2B and 2D. Wallboard secured to studs with 1-1/4 in. long Type S-12 steel screws spaced 8 in. OC at perimeter and 12 in. OC in the field. For Joint Compound see Item 5. To be used with Lead Batten Strips (see Item 9) or Lead Discs or Tabs (see Item 10).

RAY-BAR ENGINEERING CORP — Type RB-LBG

4B. **Gypsum Board* —** (As an alternate to Item 4 Systems A, B, C, D, E, G, H, and I when used as the base layer, For direct attachment only) - Nominal 5/8 in. thick lead backed gypsum panels with beveled, square or tapered edges, applied vertically. Vertical joints centered over studs and staggered min 1 stud cavity on opposite sides of studs. Wallboard secured to studs with 1-1/4 in. long Type S-12 (or #6 by 1-1/4 in. long bugle head fine driller) steel screws spaced 8 in. OC at perimeter and 12 in. OC in the field.

NEW ENGLAND LEAD BURNING CO INC, DBA NELCO — Type Nelco

4C. **Gypsum Board* —** (As an alternate to Item 4 Systems A, B, C, D, E, G, H, and I when used as the base layer, For direct attachment only) - Nom 5/8 or 3/4 in. thick lead backed gypsum panels with beveled, square or tapered edges, applied vertically. Vertical joints centered over 20 MSG steel studs and staggered min 1 stud cavity on opposite sides of studs. See Items 1, 2, 2A, 2B and 2D. Wallboard secured to studs with 1-1/4 in. long Type S-12 steel screws spaced 8 in. OC at perimeter and 12 in. OC in the field. For Joint Compound see Item 5. To be used with Lead Batten Strips (see Item 9A) or Lead Discs (see Item 10A). Lead batten strips required behind vertical joints of lead backed gypsum wallboard and optional at remaining stud locations. Lead batten strips, min 2 in. wide, max 10 ft long with a max thickness of 0.140 in. placed on the face of studs and attached to the stud with two 1 in. long Type S-8 pan head steel screws, one at the top of the strip and one at the bottom of the strip.

MAYCO INDUSTRIES INC — Type X-Ray Shielded Gypsum

4D. **Gypsum Board* —** (As an alternate to Item 4 Systems A, B, C, D, E, G, H, and I when used as the base layer, For direct attachment only). Nom 5/8 in. thick lead backed gypsum panels with beveled, square or tapered edges, applied vertically. Vertical joints centered over studs and staggered min 1 stud cavity on opposite sides of studs. Wallboard secured to studs with 1-1/4 in. long Type S-12 steel screws gypsum panel steel screws spaced 8 in. OC at perimeter and 12 in. OC in the field. Lead batten strips required behind vertical joints of lead backed gypsum wallboard

and optional at remaining stud locations. Lead batten strips, min 2 in. wide, max 8 ft long with a max thickness of 0.14 in. placed on the face of studs and attached to the stud with construction adhesive and two 1 in. long Type S-12 pan head steel screws, one at the top of the strip and one at the bottom of the strip. Lead discs, nominal 3/8 in. diam by max 0.085 in. thick. Compression fitted or adhered over the screw heads. Lead batten strips and discs to have a purity of 99.9% meeting the Federal specification QQ-L-201f, Grade "C".

RADIATION PROTECTION PRODUCTS INC — Type RPP - Lead Lined Drywall

5. **Joint Tape and Compound —** (Not Shown)

Systems A, B, C, E, F, G, H, I

Joints on outer layers of gypsum boards (Item 4 and 4A) covered with paper tape and joint compound. Paper tape and joint compound may be omitted when gypsum boards are supplied with square edges. Exposed screw heads covered with joint compound.

6. **Batts and Blankets* —**

Systems A, B, E, F, G, H, I

(Optional) — Mineral wool or glass fiber batts partially or completely filling stud cavity. Any mineral wool or glass fiber batt mineral bearing the UL Classification Marking as to Fire Resistance.

Systems C & D

Min 3 in. (System C) and min 1-1/2 in. (System D) thick mineral wool batts, friction fitted between the studs and floor and ceiling runners.

ROXUL INC — Type AFB

THERMAFIBER INC — Type SAFB

7. **Cementitious Backer Units* —** (System D) — Nom 1/2 or 5/8 in. thick panels, square edge, attached to studs over gypsum wallboard with 1-5/8 in. long, Type S-12, corrosion resistant steel screws spaced 8 in. OC and staggered 8 in. from gypsum wall board screws. Joints covered with glass fiber mesh tape. Vertical joints staggered one stud cavity from gypsum wallboard joints. Horizontal joints staggered a min of 12 in. from the gypsum wallboard joints.

UNITED STATES GYPSUM CO — Type DCB

8. **Laminating Adhesive* —** (Optional, Not Shown) — Used to bond outer layer of Cementitious Backer Units (Item 7) to inner layers of Gypsum Board (Item 4) in System D. ANSI A136.1 Type 1 organic adhesive applied with 1/4 in. square notched trowel. See Adhesives (BYWR) in the Fire Resistance Directory or Adhesives (BJLZ) in the Building Materials Directory for names of Classified companies.

9. **Lead Batten Strips —** (Not Shown, For Use With Item 4A) - Lead batten strips, min 1-1/2 in. wide, max 10 ft long with a max thickness of 0.125 in. Strips placed on the interior face of studs and attached from the exterior face of the stud with two 1 in. long Type S-12 pan head steel screws, one at the top of the strip and one at the bottom of the strip. Lead batten strips to have a purity of 99.9% meeting the Federal specification QQ-L-201f, Grade "C". Lead batten strips required behind vertical joints of lead backed gypsum wallboard (Item 4A) and optional at remaining stud locations. Required behind vertical joints.

9A. **Lead Batten Strips —** (Not Shown, for use with Item 4C) Lead batten strips, 2 in. wide, max 10 ft long with a max thickness of 0.140 in. Strips placed on the face of studs and attached to the stud with two min. 1 in. long min. Type S-8 pan head steel screws, one at the top of the strip and one at the bottom of the strip or with one min. 1 in. long min. Type S-8 pan head steel screw at the top of the strip. Lead batten strips to have a purity of 99.5% meeting the Federal specification QQ-L-201f, Grades "B, C or D".. Lead batten strips required behind vertical joints of lead backed gypsum wallboard (Item 6) and optional at remaining stud locations.

10. **Lead Discs or Tabs —** (Not Shown, For Use With Item 4A) - Used in lieu of or in addition to the lead batten strips (Item 9) or optional at other locations - Max 3/4 in. diam by max 0.125 in. thick lead discs compression fitted or adhered over steel screw heads or max 1/2 in. by 1-1/4 in. by max 0.125 in. thick lead tabs placed on gypsum boards (Item 4A) underneath screw locations prior to the installation of the screws. Lead discs or tabs to have a purity of 99.9% meeting the Federal specification QQ-L-201f, Grade "C".

10A. **Lead Discs —** (Not Shown, for use with Item 4C) Max 5/16 in. diam by max 0.140 in. thick lead discs compression fitted or adhered over steel screw heads. Lead discs to have a purity of 99.5% meeting the Federal Specification QQ-L-201f, Grades "B, C or D".

11. **Lead Batten Strips —** (Not Shown, For Use With Item 4B) Lead batten strips, 2 in. wide, max 10 ft long with a max thickness of 0.142 in. Strips placed on the face of studs and attached to the stud with two min. 1 in. long min. Type S-8 pan head steel screws, one at the top of the strip and one at the bottom of the strip or with one min. 1 in. long min. Type S-8 pan head steel screw at the top of the strip. Lead batten strips to have a purity of 99.9% meeting the Federal specification QQ-L-201f, Grade "C". Lead batten strips required behind vertical joints of lead backed gypsum wallboard (Item 4B) and optional at remaining stud locations.

12. **Lead Tabs —** (Not Shown, For Use With Item 4B) 2 in. wide, 5 in. long with a max thickness of 0.142 in. Tabs

friction-fit around front face of stud, the stud folded back flange, and the back face of the stud. Tabs required at each location where a screw (that secures the gypsum boards, Item 4B) will penetrate the steel stud. Lead tabs to have a purity of 99.9% meeting the Federal specification QQ-L-201f, Grade "C". Lead tabs may be held in place with standard adhesive tape if necessary.

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**

Last Updated on 2015-03-16

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Fire Resistance Ratings - ANSI/UL 263

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See General Information for Fire-resistance Ratings - ANSI/UL 263

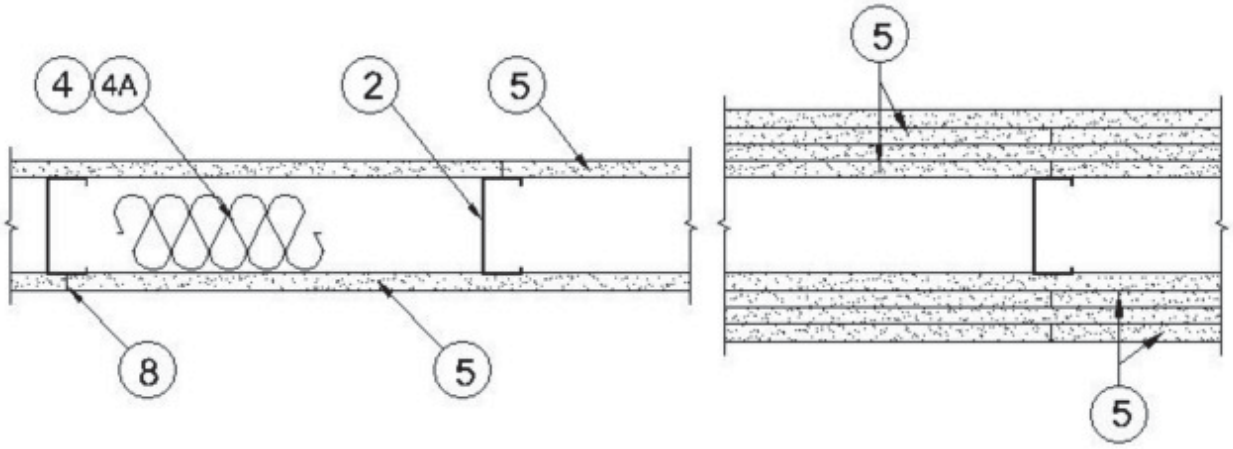
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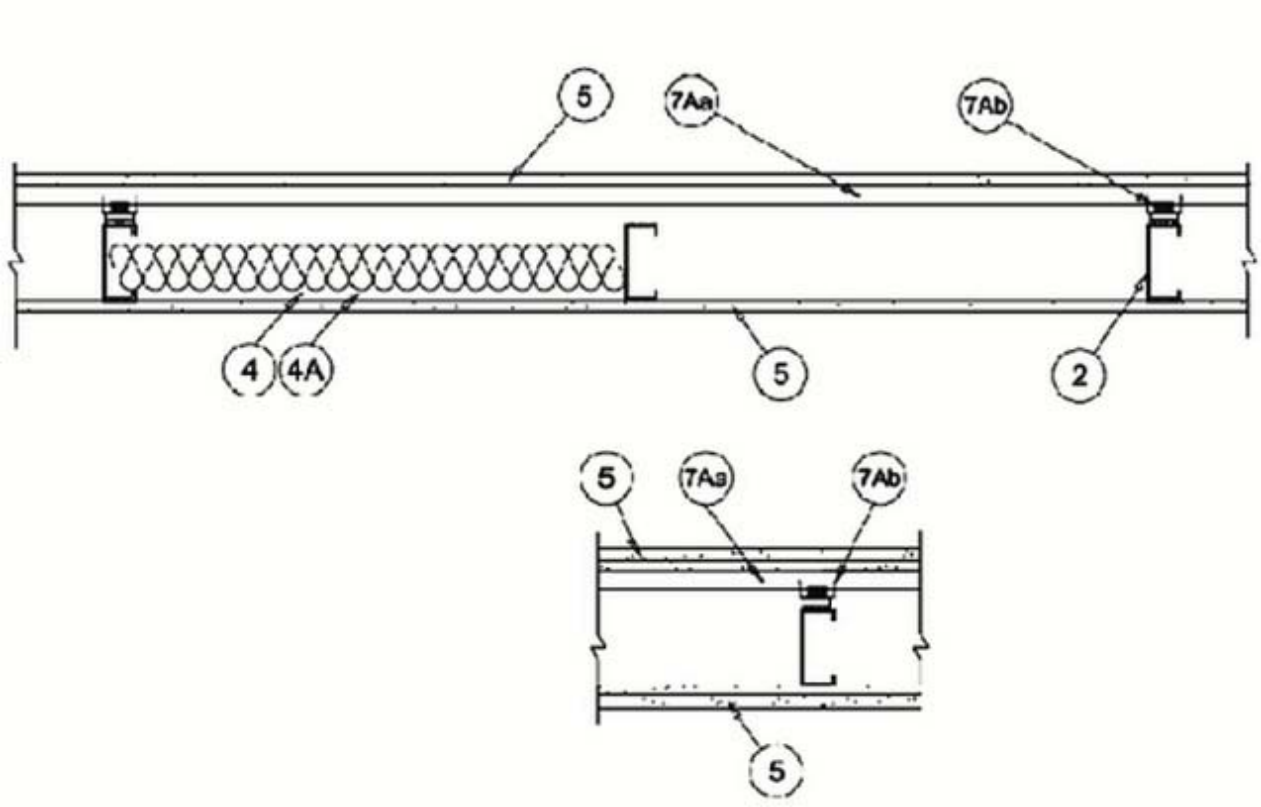
Design No. U419

February 25, 2015

Nonbearing Wall Ratings — 1, 2, 3 or 4 Hr (See Items 4 & 5)

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**





1. **Floor and Ceiling Runners —** (Not shown) — For use with Item 2 - Channel shaped, fabricated from min 25 MSG corrosion-protected steel, min depth to accommodate stud size, with min 1-1/4 in. long legs, attached to floor and ceiling with fasteners 24 in. OC max.

1A. **Framing Members* - Floor and Ceiling Runner —** Not shown - In lieu of Item 1 — For use with Item 2B, proprietary channel shaped runners, 3-5/8 in. deep attached to floor and ceiling with fasteners 24 in. OC max.

CALIFORNIA EXPANDED METAL PRODUCTS CO — Viper25™ Track

CRACO MFG INC — SmartTrack25™

MARINO/WARE, DIV OF WARE INDUSTRIES INC — Viper25™ Track

PHILLIPS MFG CO L L C — Viper25™ Track

1B. **Framing Members* - Floor and Ceiling Runner —** Not shown - In lieu of Item 1 — For use with Item 2C, proprietary channel shaped runners, 1-1/4 in. wide by 3-5/8 in. deep fabricated from min 0.020 in. thick galv steel, attached to floor and ceiling with fasteners spaced 24 in. OC max.

CALIFORNIA EXPANDED METAL PRODUCTS CO — Viper20™ Track

MARINO/WARE, DIV OF WARE INDUSTRIES INC — Viper20™ Track

PHILLIPS MFG CO L L C — Viper20™ Track

1C. **Framing Members*— Floor and Ceiling Runners —** (Not shown) — In lieu of Item 1 - Channel shaped, attached to floor and ceiling with fasteners 24 in. OC. max.

ALLSTEEL & GYPSUM PRODUCTS INC — Type SUPREME Framing System

CONSOLIDATED FABRICATORS CORP, BUILDING PRODUCTS DIV — Type SUPREME Framing System

QUAIL RUN BUILDING MATERIALS INC — Type SUPREME Framing System

SCAFCO STEEL STUD MANUFACTURING CO — Type SUPREME Framing System

STEEL CONSTRUCTION SYSTEMS INC — Type SUPREME Framing System

UNITED METAL PRODUCTS INC — Type SUPREME Framing System

1D. **Floor and Ceiling Runners —** (Not shown)—For use with Item 2A- Channel shaped, fabricated from min 20 MSG corrosion-protected or galv steel, min depth to accommodate stud size, with min 1 in. long legs, attached to floor and ceiling with fasteners spaced max 24 in. OC.

1E. **Framing Members*— Floor and Ceiling Runners —** (Not shown, As an alternate to Item 1) — For use with Items 2E, 5F or 5G or 5I only, channel shaped, fabricated from min. 0.015 in. (min bare metal thickness) galvanized steel, attached to floor and ceiling with fasteners 24 in. OC. max.

CLARKDIETRICH BUILDING SYSTEMS — CD ProTRAK

DMFCWBS L L C — ProTRAK

MBA METAL FRAMING — ProTRAK

RAM SALES L L C — Ram ProTRAK

STEEL STRUCTURAL SYSTEMS L L C — Tri-S ProTRAK

1F. **Framing Members* - Floor and Ceiling Runner —** Not shown - In lieu of Item 1 — For use with Item 2F, proprietary channel shaped runners, minimum width to accommodate stud size, with 1- 1/8 in. long legs fabricated from min 0.015 in. (min bare metal thickness) galv steel, attached to floor and ceiling with fasteners spaced 24 in. OC max.

SUPER STUD BUILDING PRODUCTS — The Edge

1G. **Framing Members* - Floor and Ceiling Runner —** For use with Item 2G, proprietary channel shaped runners, minimum width to accommodate stud size attached to floor and ceiling with fasteners 24 in. OC max.

STUDCO BUILDING SYSTEMS — CROCSTUD Track

1H. **Floor and Ceiling Runners —** (Not shown) — Channel shaped, fabricated from min 0.02 in. galv steel, min width to accommodate stud size, with min 1 in. long legs, for use with studs specified below and fabricated from min 0.02 in. galv steel or thicker, attached to floor and ceiling with fasteners spaced max 24 in. OC.

MARINO/WARE, DIV OF WARE INDUSTRIES INC — Viper20™ Track VT100.

1I. **Framing Members*— Floor and Ceiling Runners —** (Not shown, As an alternate to Item 1) — For use with Items 2H, channel shaped, fabricated from min. 0.015 in. (min bare metal thickness) galvanized steel, attached to floor and ceiling with fasteners 24 in. OC. max.

TELLING INDUSTRIES L L C — TRUE-TRACK™

1J. **Framing Members* - Floor and Ceiling Runner —** Not shown - In lieu of Item 1 — For use with Item 2I, proprietary channel shaped runners, 3-5/8 in. deep attached to floor and ceiling with fasteners 24 in. OC max.

TELLING INDUSTRIES L L C — Viper25™ Track

1K. **Framing Members* - Floor and Ceiling Runner —** Not shown - In lieu of Item 1 — For use with Item 2J, proprietary channel shaped runners, 1-1/4 in. wide by 3-5/8 in. deep fabricated from min 0.020 in. thick galv steel, attached to floor and ceiling with fasteners spaced 24 in. OC max.

TELLING INDUSTRIES L L C — Viper20™ Track

2. **Steel Studs —** Channel shaped, fabricated from min 25 MSG corrosion-protected steel, min depth as indicated under Item 5, spaced a max of 24 in. OC. Studs to be cut 3/8 to 3/4 in. less than assembly height.

2A. **Steel Studs —** (As an alternate to Item 2, For use with Items 5B, 5E, 5H and 5J) Channel shaped, fabricated from min 20 MSG corrosion-protected or galv steel, 3-1/2 in. min depth, spaced a max of 16 in. OC. Studs friction-fit into floor and ceiling runners. Studs to be cut 5/8 to 3/4 in. less than assembly height.

2B. **Framing Members* - Steel Studs —** (As an alternate to Item 2, For use with Items 5C, 5I or 5K) - Proprietary channel shaped studs, 3-5/8 in. deep spaced a max of 24 in. OC. Studs to be cut 3/4 in less than the assembly height and installed with a 1/2 in. gap between the end of the stud and track at the bottom of the wall. For direct attachment of gypsum board only.

CALIFORNIA EXPANDED METAL PRODUCTS CO — Viper25™

CRACO MFG INC — SmartStud25™

MARINO/WARE, DIV OF WARE INDUSTRIES INC — Viper25™

PHILLIPS MFG CO L L C — Viper25™

2C. **Framing Members* - Steel Studs —** Not shown - In lieu of Item 2 — proprietary channel shaped steel studs, min depth as indicated under Item 5, spaced a max if 24 in. OC, fabricated from min 0.020 in. thick galv steel. Studs cut 3/8 in. to 3/4 in. less in lengths than assembly heights.

CALIFORNIA EXPANDED METAL PRODUCTS CO — Viper20™

MARINO/WARE, DIV OF WARE INDUSTRIES INC — Viper20™

PHILLIPS MFG CO L L C — Viper20™

2D. **Framing Members*— Steel Studs —** In lieu of Item 2 - Channel shaped studs, min depth as indicated under Item 5, spaced a max of 24 in. OC. Studs to be cut 3/4 in. less than assembly height.

ALLSTEEL & GYPSUM PRODUCTS INC — Type SUPREME Framing System

CONSOLIDATED FABRICATORS CORP, BUILDING PRODUCTS DIV — Type SUPREME Framing System

QUAIL RUN BUILDING MATERIALS INC — Type SUPREME Framing System

SCAFCO STEEL STUD MANUFACTURING CO — Type SUPREME Framing System

STEEL CONSTRUCTION SYSTEMS INC — Type SUPREME Framing System

UNITED METAL PRODUCTS INC — Type SUPREME Framing System

2E. **Framing Members*— Steel Studs —** (Not shown, As an alternate to Item 2) —For use with Items 5F or 5G or 5I only, channel shaped studs, min depth as indicated under Item 5F, 5G or 5I, fabricated from min. 0.015 in. (min bare metal thickness) galvanized steel, spaced a max of 24 in. OC. Studs to be cut 3/4 in. less than assembly height.

CLARKDIETRICH BUILDING SYSTEMS — CD ProSTUD

DMFCWBS L L C — ProSTUD

MBA METAL FRAMING — ProSTUD

RAM SALES L L C — Ram ProSTUD

STEEL STRUCTURAL SYSTEMS L L C — Tri-S ProSTUD

2F. **Framing Members* - Steel Studs —** Not shown - In lieu of Item 2 — proprietary channel shaped steel studs, minimum width indicated under Item 5, 1-1/4 in. deep fabricated from min 0.015 in. (min bare metal thickness) galvanized steel. Studs 3/8 in. to 3/4 in. less in lengths than assembly heights.

SUPER STUD BUILDING PRODUCTS — The Edge

2G. **Framing Members* - Steel Studs —** Not shown - In lieu of Item 2 - proprietary channel shaped studs, minimum width indicated under Item 5, Studs to be cut 3/8 to 3/4 in less than the assembly height.

STUDCO BUILDING SYSTEMS — CROCSTUD

2H. **Framing Members*— Steel Studs —** (Not shown, As an alternate to Item 2) — Fabricated from min. 0.015 in. (min bare metal thickness) galvanized steel, spaced a max of 24 in. OC. Studs to be cut 3/4 in. less than assembly height.

TELLING INDUSTRIES L L C — TRUE-STUD™

2I. **Framing Members* - Steel Studs —** (As an alternate to Item 2, For use with Items 5C or 5L) - Proprietary channel shaped studs, 3-5/8 in. deep spaced a max of 24 in. OC. Studs to be cut 3/4 in less than the assembly height and installed with a ½ in. gap between the end of the stud and track at the bottom of the wall. For direct attachment of gypsum board only.

TELLING INDUSTRIES L L C — Viper25™

2J. **Framing Members* - Metal Studs —** Not shown - In lieu of Item 2 — proprietary channel shaped steel studs, min depth as indicated under Item 5, spaced a max if 24 in. OC, fabricated from min 0.020 in. thick galv steel. Studs cut 3/8 in. to 3/4 in. less in lengths than assembly heights

TELLING INDUSTRIES L L C — Viper20™

2K. **Framing Members*— Steel Studs —** As an alternate to Item 2 - For use with Item 1, channel shaped studs, fabricated from min 25 MSG corrosion-protected steel, min depth as indicated under Item 5, spaced a max of 24 in. OC. Studs to be cut 3/8 to 3/4 in. less than assembly height.

EB MéTAL INC — EB Stud

2L. **Framing Members*— Steel Studs —** As an alternate to Item 2 - For use with Item 1, channel shaped studs, fabricated from min 25 MSG corrosion-protected steel, min depth as indicated under Item 5, spaced a max of 24 in. OC. Studs to be cut 3/8 to 3/4 in. less than assembly height.

OLMAR SUPPLY INC — PRIMESTUD

3. **Wood Structural Panel Sheathing —** (Optional, For use with Item 5 Only.)- (Not Shown) - 4 ft wide, 7/16 in. thick oriented strand board (OSB) or 15/32 in. thick structural 1 sheathing (plywood) complying with DOC PS1 or PS2, or APA Standard PRP-108, manufactured with exterior glue, applied horizontally or vertically to the steel studs. Vertical joints centered on studs, and staggered one stud space from wallboard joints. Attached to studs with flat-head self-drilling tapping screws with a min. head diam. of 0.292 in. at maximum 6 in. OC. in the perimeter and 12 in. OC. in the field. When used, fastener lengths for gypsum panels increased by min. 1/2 in.

4. **Batts and Blankets* —** (Required as indicated under Item 5) — Mineral wool batts, friction fitted between studs and runners. Min nom thickness as indicated under Item 5. See **Batts and Blankets (BKNV or BZJZ) Categories** for names of Classified companies.

4A. **Batts and Blankets* —** (Optional) — Placed in stud cavities, any glass fiber or mineral wool insulation bearing the UL Classification Marking as to Surface Burning Characteristics and/or Fire Resistance. See **Batts and Blankets (BKNV or BZJZ) Categories** for names of Classified companies.

4B. **Batts and Blankets* —** Placed in stud cavities, any 3-1/2 in. thick glass fiber insulation bearing the UL Classification Marking as to Surface Burning Characteristics and/or Fire Resistance. See **Batts and Blankets (BKNV or BZJZ) Categories** for names of Classified companies.

5. **Gypsum Board* —** Gypsum panels with beveled, square or tapered edges, applied vertically or horizontally. Vertical joints centered over studs and staggered one stud cavity on opposite sides of studs. Vertical joints in adjacent layers (multilayer systems) staggered one stud cavity. Horizontal joints need not be backed by steel framing. Horizontal edge joints and horizontal butt joints on opposite sides of studs need not be staggered. Horizontal edge joints and horizontal butt joints in adjacent layers (multilayer systems) staggered a min of 12 in. The thickness and number of layers for the 1 hr, 2 hr, 3 hr and 4 hr ratings are as follows:

Gypsum Board Protection on Each Side of Wall

Rating, Hr	Min Stud Depth, in. Items 2, 2C, 2D, 2F and 2G	No. of Layers & Thkns of Panel	Min Thkns of Insulation (Item 4)
1	3-1/2	1 layer, 5/8 in. thick	Optional
1	2-1/2	1 layer, 1/2 in. thick	1-1/2 in.
1	1-5/8	1 layer, 3/4 in. thick	Optional
2	1-5/8	2 layers, 1/2 in. thick	Optional
2	1-5/8	2 layers, 5/8 in. thick	Optional
2	3-1/2	1 layer, 3/4 in. thick	3 in.
3	1-5/8	3 layers, 1/2 in. thick	Optional
3	1-5/8	2 layers, 3/4 in. thick	Optional
3	1-5/8	3 layers, 5/8 in. thick	Optional
4	1-5/8	4 layers, 5/8 in. thick	Optional
4	1-5/8	4 layers, 1/2 in. thick	Optional
4	2-1/2	2 layers, 3/4 in. thick	2 in.

CGC INC — 1/2 in. thick Type C, IP-X2 or IPC-AR; WRC, 5/8 in. thick Type AR, C, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, WRX or WRC; 3/4 in. thick Types IP-X3 or ULTRACODE

UNITED STATES GYPSUM CO — 1/2 in. thick Type C, IP-X2, IPC-AR or WRC; 5/8 in. thick Type SCX, SGX, SHX, WRX, IP-X1, AR, C, WRC, FRX-G, IP-AR, IP-X2, IPC-AR ; 3/4 in. thick Types IP-X3 or ULTRACODE

USG MEXICO S A DE C V — 1/2 in. thick Type C, IP-X2, IPC-AR or WRC; 5/8 in. thick Type AR, C, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, WRX, WRC or; 3/4 in. thick Types IP-X3 or ULTRACODE

When Item 7B, Steel Framing Members*, is used, Nonbearing Wall Rating is limited to 1 Hr. Min. stud depth is 3-1/2 in., min. thickness of insulation (Item 4) is 3 in., and two layers of gypsum board panels (1/2 in. or 5/8 in. thick) shall be attached to furring channels as described in Item 6. One layer of gypsum board panels (1/2 in. or 5/8 in. thick) attached to opposite side of stud without furring channels as described in Item 6.

5A. **Gypsum Board* —** (As an alternate to Item 5) — 5/8 in. thick, 24 to 54 in. wide, applied horizontally as the outer layer to one side of the assembly. Secured as described in Item 6.

CGC INC — Type SHX.

UNITED STATES GYPSUM CO — Type FRX-G, SHX.

USG MEXICO S A DE C V — Type SHX.

5B. **Gypsum Board* —** (Not Shown) - As an alternate to Item 5 when used as the base layer on one or both sides of wall when 5/8 in or ¾ in. thick products are specified. For direct attachment only to steel studs Item 2A, (not to be used with Item 3) - Nom 5/8 in. or ¾ in. may be used as alternate to all 5/8 in. or ¾ in. shown in Item 5, Wallboard Protection on Each Side of Wall table. Nom 5/8 in. or ¾ in. thick lead backed gypsum panels with beveled, square or tapered edges, applied vertically. Vertical joints centered over studs and staggered min 1 stud cavity on opposite sides of studs. Gypsum board secured to 20 MSG steel studs Item 2A with 1-1/4 in. long Type S-12 steel screws spaced 8 in. OC at perimeter and 12 in. OC in the field. To be used with Lead Batten Strips (see Item 11) or Lead Discs or Tabs (see Item 12).

RAY-BAR ENGINEERING CORP — Type RB-LBG

5C. **Gypsum Board* —** (For Use With Item 2B) Rating Limited to 1 Hour. 5/8 in. thick, 48 in. wide, Gypsum panels with beveled, square or tapered edges, applied vertically or horizontally. (Vertical Application) - The gypsum board is to be installed on each side of the studs with 1 in. long Type S coated steel screws spaced 8 in. OC starting 4 in. from the edge of the board at the vertical edges and 12 in. OC starting 6 in. from the edge of the board at the center of each board. Gypsum boards are to be secured to the top and bottom track with screws spaced 8 in. OC starting 4 in. from

the board edge. Fasteners shall not penetrate through both the stud and the track at the same time. Vertical joints are to be centered over studs and staggered one stud cavity on opposite sides of studs. (Horizontal Application) - The gypsum board is to be installed on each side of the studs with 1 in. long Type S coated steel screws spaced 8 in. OC starting 4 in. from the edge of the board at the vertical edges and 12 in. OC starting 6 in. from the edge of the board at the center of each board. Gypsum boards are to be secured to the top and bottom track with screws spaced 8 in. OC starting 4 in. from the board edge. Fasteners shall not penetrate through both the stud and the track at the same time. All horizontal joints are to be backed as outlined under section VI of Volume 1 in the Fire Resistive Directory.

CGC INC — Type SCX.

UNITED STATES GYPSUM CO — Type SCX, SGX.

USG MEXICO S A DE C V — Type SCX.

5D. **Gypsum Board* —** (As an alternate to Item 5) — 5/8 in. thick, 48 in. wide, applied vertically or horizontally. Secured as described in Item 6. For use with Items 1 and 2 only.

UNITED STATES GYPSUM CO — Type USGX.

5E. **Gypsum Board* —** (Not Shown) - (As an alternate to Item 5 when used as the base layer on one or both sides of wall when 1/2 in. or 5/8 in thick products are specified, For direct attachment only to steel studs Item 2A, not to be used with Item 3). Nominal 5/8 in. thick lead backed gypsum panels with beveled, square or tapered edges, applied vertically. Vertical joints centered over studs and staggered min 1 stud cavity on opposite sides of studs. Wallboard secured to studs with 1-1/4 in. long Type S-12 (or No. 6 by 1-1/4 in. long bugle head fine driller) steel screws spaced 8 in. OC at perimeter and 12 in. OC in the field.

NEW ENGLAND LEAD BURNING CO INC, DBA NELCO — Nelco

5F. **Gypsum Board* —** (As an alternate to Item 5) — For use with Items 1E and 2E and limited to 1 Hour Rating only, Gypsum panels with beveled, square or tapered edges, applied vertically, and fastened to the steel studs with 1 in. long Type S screws spaced 8 in. OC along vertical and bottom edges and 12 in. OC in the field. Vertical joints centered over studs and staggered one stud cavity on opposite sides of studs. Steel stud depth shall be a minimum 3-5/8 in.

UNITED STATES GYPSUM CO — 5/8 in. thick Type SCX, SGX.

5G. **Gypsum Board* —** (As an alternate to Item 5) — For use with Items 1E and 2E only, Gypsum panels with beveled, square or tapered edges, applied vertically or horizontally, as specified in the table below and fastened to the steel studs as described in Item 6. Vertical joints centered over studs and staggered one stud cavity on opposite sides of studs. Vertical joints in adjacent layers (multilayer systems) staggered one stud cavity. Horizontal joints need not be backed by steel framing. Horizontal edge joints and horizontal butt joints on opposite sides of studs need not be staggered. Horizontal edge joints and horizontal butt joints in adjacent layers (multilayer systems) staggered a min of 12 in. The thickness and number of layers for the 2 hr, 3 hr and 4 hr ratings are as follows:

Gypsum Board Protection on Each Side of Wall

Rating, Hr	Min Stud Depth, in. Item 2E	No. of Layers & Thickness of Panel	Min Thkns of Insulation (Item 4)
2	1-5/8	2 layers, 1/2 in. thick	Optional
2	1-5/8	2 layers, 5/8 in. thick	Optional
3	1-5/8	3 layers, 1/2 in. thick	Optional
3	1-5/8	3 layers, 5/8 in. thick	Optional
4	1-5/8	4 layers, 5/8 in. thick	Optional
4	1-5/8	4 layers, 1/2 in. thick	Optional

CGC INC — 1/2 in. thick Type C, IP-X2 or IPC-AR;, 5/8 in. thick Type AR, C, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, or; 3/4 in. thick Types IP-X3 or ULTRACODE

UNITED STATES GYPSUM CO — 1/2 in. thick Type C, IP-X2, IPC-AR or; 5/8 in. thick Type SCX, SGX, SHX, IP-X1, AR, C, , FRX-G, IP-AR, IP-X2, IPC-AR ; 3/4 in. thick Types IP-X3 or ULTRACODE

USG MEXICO S A DE C V — 1/2 in. thick Type C, IP-X2, IPC-AR or; 5/8 in. thick Type AR, C, IP-AR, IP-X1, IP-X2,

IPC-AR, SCX, SHX, or; 3/4 in. thick Types IP-X3 or ULTRACODE

5H. **Gypsum Board* —** (Not Shown) - (As an alternate to Item 5 when used as the base layer on one or both sides of wall when 5/8 or 3/4 in thick products are specified. For direct attachment only to steel studs Item 2A, (not to be used with Item 3) - Nom 5/8 or 3/4 in. may be used as alternate to all 5/8 or 3/4 in. shown in Item 5, Wallboard Protection on Each Side of Wall table. Nom 5/8 or 3/4 in. thick lead backed gypsum panels with beveled, square or tapered edges, applied vertically. Vertical joints centered over 20 MSG steel studs and staggered min 1 stud cavity on opposite sides of studs. Wallboard secured to studs with 1-1/4 in. long Type S-12 steel screws spaced 8 in. OC at perimeter and 12 in. OC in the field. Gypsum board secured to 20 MSG steel studs Item 2B with 1-1/4 in. long Type S-12 steel screws spaced 8 in. OC at perimeter and 12 in. OC in the field. For Joint Compound see Item 5. To be used with Lead Batten Strips (see Item 11A) or Lead Discs (see Item 12A).

MAYCO INDUSTRIES INC — Type X-Ray Shielded Gypsum

5I. **Gypsum Board* —** (As an alternate to Item 5) - Nom. 5/8 in. thick gypsum panels with beveled, square or tapered edges installed as described in Item 5. Steel stud minimum depth shall be as indicated in Item 5.

CGC INC — Type ULX

UNITED STATES GYPSUM CO — Type ULX

USG MEXICO S A DE C V — Type ULX

5J. **Gypsum Board* —** (Not Shown) - (As an alternate to Item 5 when used as the base layer on one or both sides of wall when 1/2 in. or 5/8 in thick products are specified, For direct attachment only to steel studs Item 2A, not to be used with Item 3). Nom 5/8 in. thick lead backed gypsum panels with beveled, square or tapered edges, applied vertically. Vertical joints centered over studs and staggered min 1 stud cavity on opposite sides of studs. Wallboard secured to studs with 1-1/4 in. long Type S-12 steel screws gypsum panel steel screws spaced 8 in. OC at perimeter and 12 in. OC in the field. Lead batten strips required behind vertical joints of lead backed gypsum wallboard and optional at remaining stud locations. Lead batten strips, min 2 in. wide, max 8 ft long with a max thickness of 0.14 in. placed on the face of studs and attached to the stud with construction adhesive and two 1 in. long Type S-12 pan head steel screws, one at the top of the strip and one at the bottom of the strip. Lead discs, nominal 3/8 in. diam by max 0.085 in. thick. Compression fitted or adhered over the screw heads. Lead batten strips and discs to have a purity of 99.9% meeting the Federal specification QQ-L-201f, Grade "C".

RADIATION PROTECTION PRODUCTS INC — Type RPP - Lead Lined Drywall

5K. **Gypsum Board* —** Nom. 5/8 in. thick gypsum panels with beveled, square or tapered edges installed as described in Item 5. Insulation (Item 4B) required. The steel stud size and type and number of layers are as follows:

Gypsum Board Protection on Each Side of Wall

Rating, Hr	Min Stud Depth, in. Items 2, 2B	No. of Layers & Thickness of Panel
1	3-5/8	1 layer, 5/8 in. thick

UNITED STATES GYPSUM CO — 5/8 in. thick Type ULIX

6. **Fasteners —** (Not shown) — For use with Items 2 and 2F - Type S or S-12 steel screws used to attach panels to studs (Item 2) or furring channels (Item 7). **Single layer systems:** 1 in. long for 1/2 and 5/8 in. thick panels or 1-1/4 in. long for 3/4 in. thick panels, spaced 8 in. OC when panels are applied horizontally, or 8 in. OC along vertical and bottom edges and 12 in. OC in the field when panels are applied vertically. **Two layer systems:** First layer- 1 in. long for 1/2 and 5/8 in. thick panels or 1-1/4 in. long for 3/4 in. thick panels, spaced 16 in. OC. Second layer- 1-5/8 in. long for 1/2 in., 5/8 in. thick panels or 2-1/4 in. long for 3/4 in. thick panels, spaced 16 in. OC with screws offset 8 in. from first layer.**Three-layer systems:** First layer- 1 in. long for 1/2 in., 5/8 in. thick panels, spaced 24 in. OC. Second layer- 1-5/8 in. long for 1/2 in., 5/8 in. thick panels, spaced 24 in. OC. Third layer- 2-1/4 in. long for 1/2 in., 5/8 in. thick panels or 2-5/8 in. long for 5/8 in. thick panels, spaced 12 in. OC. Screws offset min 6 in. from layer below. **Four-layer systems:** First layer- 1 in. long for 1/2 in., 5/8 in. thick panels, spaced 24 in. OC. Second layer- 1-5/8 in. long for 1/2 in., 5/8 in. thick panels, spaced 24 in. OC. Third layer- 2-1/4 in. long for 1/2 in. thick panels or 2-5/8 in. long for 5/8 in. thick panels, spaced 24 in. OC. Fourth layer- 2-5/8 in. long for 1/2 in. thick panels or 3 in. long for 5/8 in. thick panels, spaced 12 in. OC. Screws offset min 6 in. from layer below.

7. **Furring Channels —** (Optional, not shown, for single or double layer systems) — Resilient furring channels fabricated from min 25 MSG corrosion-protected steel, spaced vertically a max of 24 in. OC. Flange portion attached to each intersecting stud with 1/2 in. long Type S-12 steel screws. Not for use with Item 5A and 5E.

7A. **Framing Members* —** (Optional on one or both sides, not shown, for single or double layer systems) — As an

alternate to Item 7, furring channels and Steel Framing Members as described below:

a. **Furring Channels —** Formed of No. 25 MSG galv steel. 2-9/16 in. or 2-23/32 in. wide by 7/8 in. deep, spaced max. 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Gypsum board attached to furring channels as described in Item 6. Not for use with Item 5A and 5E.

b. **Steel Framing Members* —** Used to attach furring channels (Item 7Aa) to studs (Item 2). Clips spaced max. 48 in. OC. RSIC-1 and RSIC-1 (2.75) clips secured to studs with No. 8 x 1-1/2 in. minimum self-drilling, S-12 steel screw through the center grommet. RSIC-V and RSIC-V (2.75) clips secured to studs with No. 8 x 9/16 in. minimum self-drilling, S-12 steel screw through the center hole. Furring channels are friction fitted into clips. RSIC-1 and RSIC-V clips for use with 2-9/16 in. wide furring channels. RSIC-1 (2.75) and RSIC-V (2.75) clips for use with 2-23/32 in. wide furring channels.

PAC INTERNATIONAL INC — Types RSIC-1, RSIC-V, RSIC-1 (2.75), RSIC-V (2.75).

7B. **Framing Members* —** (Optional, Not Shown) — As an alternate to Item 7, for single or double layer systems, furring channels and Steel Framing Members on only one side of studs as described below:

a. **Furring Channels —** Formed of No. 25 MSG galv steel, spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Batts and Blankets placed in stud cavity as described in Item 5. Two layers of gypsum board attached to furring channels as described in Item 5. Not for use with Item 5A and 5E.

b. **Steel Framing Members* —** Used to attach furring channels (Item 7Ba) to one side of studs (Item 2) only. Clips spaced 48 in. OC., and secured to studs with two No. 8 x 2-1/2 in. coarse drywall screws, one through the hole at each end of the clip. Furring channels are friction fitted into clips.

KINETICS NOISE CONTROL INC — Type Isomax

7C. **Framing Members* —** (Not Shown) — (Optional on one or both sides, not shown, for single or double layer systems) — As an alternate to Item 7, furring channels and Steel Framing Members as described below:

a. **Furring Channels —** Formed of No. 25 MSG galv steel. 2-3/8 in. wide by 7/8 in. deep, spaced max. 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Gypsum board attached to furring channels as described in Item 6. Not for use with Item 5A and 5E.

b. **Steel Framing Members* —** Used to attach furring channels (Item 7Aa) to studs (Item 2). Clips spaced max. 48 in. OC. GENIECLIPS secured to studs with No. 8 x 1-1/2 in. minimum self-drilling, S-12 steel screw through the center grommet. Furring channels are friction fitted into clips.

PLITEQ INC — Type GENIECLIP

7D. **Steel Framing Members —** (Optional, Not Shown)* - Furring channels and resilient sound isolation clip as described below:

a. **Furring Channels —** Formed of No. 25 MSG galv steel. Spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels overlapped 6 in. and secured together with four self-tapping No. 8x1/2 Self Drilling screws (2 per side 1 in. and 4 in. from overlap edge). Gypsum board attached to furring channels as described in Item 4. Side joint furring channels shall be attached to studs with RESILMOUNT Sound Isolation Clips - located approximately 2 in. from each end of length of channel. Both Gypsum Boards at side joints fastened into channel with screws spaced 8 in. OC, approximately 1/2 in. from joint edge. Not for use with Item 5A and 5E.

b. **Steel Framing Members* —** Resilient sound isolation clip used to attach furring channels (Item 7Da) to studs. Clips spaced 24 in. OC., and secured to studs with No. 10 x 2-1/2 in. coarse drywall screw through the center hole. Furring channels are friction fitted into clips.

STUDCO BUILDING SYSTEMS — RESILMOUNT Sound Isolation Clips - Type A237 or A237R

8. **Joint Tape and Compound —** Vinyl or casein, dry or premixed joint compound applied in two coats to joints and screw heads of outer layers. Paper tape, nom 2 in. wide, embedded in first layer of compound over all joints of outer layer panels. Paper tape and joint compound may be omitted when gypsum panels are supplied with a square edge.

9. **Siding, Brick or Stucco —** (Optional, not shown) — Aluminum, vinyl or steel siding, brick veneer or stucco, meeting the requirements of local code agencies, installed over gypsum panels. Brick veneer attached to studs with corrugated metal wall ties attached to each stud with steel screws, not more than each sixth course of brick.

10. **Caulking and Sealants* —** (Optional, not shown) — A bead of acoustical sealant applied around the partition perimeter for sound control.

UNITED STATES GYPSUM CO — Type AS

11. **Lead Batten Strips —** (Not Shown, For Use With Item 5B) - Lead batten strips, min 1-1/2 in. wide, max 10 ft long with a max thickness of 0.125 in. Strips placed on the interior face of studs and attached from the exterior face of the stud with two 1 in. long Type S-12 pan head steel screws, one at the top of the strip and one at the bottom of the strip. Lead batten strips to have a purity of 99.9% meeting the Federal specification QQ-L-201f, Grade "C". Lead batten strips required behind vertical joints of lead backed gypsum wallboard (Item 5B) and optional at remaining stud locations. Required behind vertical joints.

11A. **Lead Batten Strips —** (Not Shown, For Use With Item 5H) Lead batten strips, 2 in. wide, max 10 ft long with a max thickness of 0.140 in. Strips placed on the face of studs and attached to the stud with two min. 1 in. long min. Type S-8 pan head steel screws, one at the top of the strip and one at the bottom of the strip or with one min. 1 in. long min. Type S-8 pan head steel screw at the top of the strip. Lead batten strips to have a purity of 99.5% meeting the Federal specification QQ-L-201f, Grades "B, C or D". Lead batten strips required behind vertical joints of lead backed gypsum wallboard and optional at remaining stud locations.

12. **Lead Discs or Tabs —** (Not Shown, For Use With Item 5B) - Used in lieu of or in addition to the lead batten strips (Item 11) or optional at other locations - Max 3/4 in. diam by max 0.125 in. thick lead discs compression fitted or adhered over steel screw heads or max 1/2 in. by 1-1/4 in. by max 0.125 in. thick lead tabs placed on gypsum boards (Item 5B) underneath screw locations prior to the installation of the screws. Lead discs or tabs to have a purity of 99.9% meeting the Federal specification QQ-L-201f, Grade "C".

12A. **Lead Discs —** (Not Shown, for use with Item 5H) Max 5/16 in. diam by max 0.140 in. thick lead discs compression fitted or adhered over steel screw heads. Lead discs to have a purity of 99.5% meeting the Federal Specification QQ-L-201f, Grades "B, C or D".

13. **Lead Batten Strips —** (Not Shown, For Use With Item 5E) Lead batten strips, 2 in. wide, max 10 ft long with a max thickness of 0.142 in. Strips placed on the face of studs and attached to the stud with two min. 1 in. long min. Type S-8 pan head steel screws, one at the top of the strip and one at the bottom of the strip or with one min. 1 in. long min. Type S-8 pan head steel screw at the top of the strip. Lead batten strips to have a purity of 99.9% meeting the Federal specification QQ-L-201f, Grade "C". Lead batten strips required behind vertical joints of lead backed gypsum wallboard (Item 5E) and optional at remaining stud locations.

14. **Lead Tabs —** (Not Shown, For Use With Item 5E) 2 in. wide, 5 in. long with a max thickness of 0.142 in. Tabs friction-fit around front face of stud, the stud folded back flange, and the back face of the stud. Tabs required at each location where a screw (that secures the gypsum boards, Item 5E) will penetrate the steel stud. Lead tabs to have a purity of 99.9% meeting the Federal specification QQ-L-201f, Grade "C". Lead tabs may be held in place with standard adhesive tape if necessary.

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**

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ONLINE CERTIFICATIONS DIRECTORY

Design No. U465
BXUV.U465
Fire Resistance Ratings - ANSI/UL 263

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BXUV - Fire Resistance Ratings - ANSI/UL 263

BXUV7 - Fire Resistance Ratings - CAN/ULC-S101 Certified for Canada

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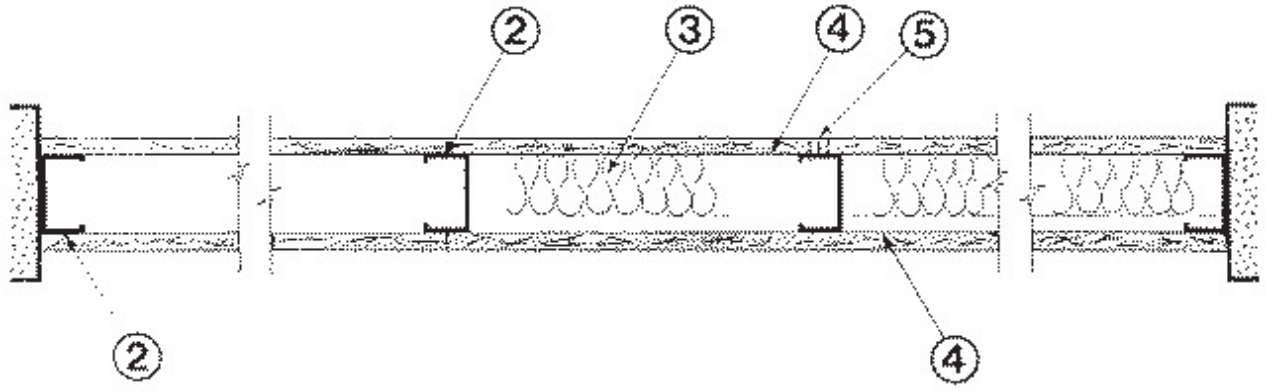
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Design No. U465

April 08, 2015

Nonbearing Wall Rating — 1 HR.

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**



1. **Floor and Ceiling Runners —** (Not shown) — Channel shaped runners, 3-5/8 in. deep (min), 1-1/4 in. legs, formed from min No. 25 MSG galv steel, attached to floor and ceiling with fasteners spaced 24 in. OC max.

1A. **Framing Members*— Floor and Ceiling Runners —** (Not shown) — As an alternate to Item 1 - Channel shaped, min 3-5/8 in. deep, attached to floor and ceiling with fasteners 24 in. OC. max.

ALLSTEEL & GYPSUM PRODUCTS INC — Type SUPREME Framing System

CONSOLIDATED FABRICATORS CORP, BUILDING PRODUCTS DIV — Type SUPREME Framing System

QUAIL RUN BUILDING MATERIALS INC — Type SUPREME Framing System

SCAFCO STEEL STUD MANUFACTURING CO — Type SUPREME Framing System

STEEL CONSTRUCTION SYSTEMS INC — Type SUPREME Framing System

UNITED METAL PRODUCTS INC — Type SUPREME Framing System

1B. **Framing Members* - Floor and Ceiling Runners —** Not shown - In lieu of Item 1 — For use with Item 2B, proprietary channel shaped runners, 1-1/4 in. wide by min 3-5/8 in. deep fabricated from min 0.020 in. thick galv steel, attached to floor and ceiling with fasteners spaced 24 in. OC max.

CALIFORNIA EXPANDED METAL PRODUCTS CO — Viper20™ Track

CRACO MFG INC — SmartTrack20™

MARINO/WARE, DIV OF WARE INDUSTRIES INC — Viper20™ Track

PHILLIPS MFG CO L L C — Viper20™ Track

1C. **Floor and Ceiling Runners —** (Not shown)—For use with Item 2C- Channel shaped, fabricated from min 20 MSG corrosion-protected or galv steel, min depth to accommodate stud size, with min 1 in. long legs, attached to floor and ceiling with fasteners spaced max 24 in. OC.

1D. **Framing Members*— Floor and Ceiling Runners —** Not shown - In lieu of Items 1 through 1C — For use with Item 2D and 4G only, proprietary channel shaped runners, 1-1/4 in. deep by min 3-5/8 in. wide fabricated from min 0.018 in. thick galv steel, attached to floor and ceiling with fasteners spaced 24 in. OC max.

CLARKDIETRICH BUILDING SYSTEMS — CD ProTRAK

DMFCWBS L L C — ProTRAK

MBA METAL FRAMING — ProTRAK

RAM SALES L L C — Ram ProTRAK

STEEL STRUCTURAL SYSTEMS L L C — Tri-S ProTRAK

1E. **Framing Members*— Floor and Ceiling Runners —** Not shown - In lieu of Items 1 through 1D — For use with Item 2E and 4I only, proprietary channel shaped runners, 1-1/4 in. deep by min 3-5/8 in. wide fabricated from min 0.018 in. thick galv steel, attached to floor and ceiling with fasteners spaced 24 in. OC max.

TELLING INDUSTRIES L L C — TRUE-TRACK™

1F. **Framing Members*— Floor and Ceiling Runners —** Not shown - In lieu of Items 1 through 1E — For use with Item 2, channel shaped runners, 1-1/4 in. deep by min 3-5/8 in. wide fabricated from min 25 MSG steel, attached to floor and ceiling with fasteners spaced 24 in. OC max.

KIRII (HONG KONG) LTD — Type KIRII

1G. **Framing Members*— Floor and Ceiling Runners —** Not shown - In lieu of Items 1 through 1F — For use with Item 2, channel shaped runners, 1-1/4 in. deep by min 3-5/8 in. wide, attached to floor and ceiling with fasteners spaced 24 in. OC max.

STUDCO BUILDING SYSTEMS — CROCSTUD Track

1H. **Floor and Ceiling Runners —** (Not shown) — Channel shaped, fabricated from min 0.02 in. galv steel, min width to accommodate stud size, with min 1 in. long legs, for use with studs specified below and fabricated from min 0.02 in. galv steel or thicker, attached to floor and ceiling with fasteners spaced max 24 in. OC.

MARINO/WARE, DIV OF WARE INDUSTRIES INC — Viper20™ Track VT100.

1I. **Framing Members* - Floor and Ceiling Runners —** Not shown - In lieu of Item 1 — For use with Item 2H, proprietary channel shaped runners, 1-1/4 in. wide by min 3-5/8 in. deep fabricated from min 0.020 in. thick galv steel, attached to floor and ceiling with fasteners spaced 24 in. OC max.

TELLING INDUSTRIES L L C — Viper20™ Track

2. **Steel Studs —** Channel shaped, 3-5/8 in. deep (min), formed from min No. 25 MSG galv steel spaced 24 in. OC max. Studs to be cut 3/4 in. less than assembly height.

2A. **Framing Members*— Steel Studs —** As an alternate to Item 2 - Channel shaped studs, min 3-5/8 in. deep, spaced a max of 24 in. OC. Studs to be cut 3/4 in. less than assembly height.

ALLSTEEL & GYPSUM PRODUCTS INC — Type SUPREME Framing System

CONSOLIDATED FABRICATORS CORP, BUILDING PRODUCTS DIV — Type SUPREME Framing System

QUAIL RUN BUILDING MATERIALS INC — Type SUPREME Framing System

SCAFCO STEEL STUD MANUFACTURING CO — Type SUPREME Framing System

STEEL CONSTRUCTION SYSTEMS INC — Type SUPREME Framing System

UNITED METAL PRODUCTS INC — Type SUPREME Framing System

2B. **Framing Members* - Steel Studs —** Not shown - In lieu of Item 2 — For use with Item 1B, proprietary channel shaped steel studs, 1-1/4 in. wide by min 3-5/8 in. deep fabricated from min 0.020 in. thick galv steel. Studs cut 3/4 in. less in length than assembly height.

CALIFORNIA EXPANDED METAL PRODUCTS CO — Viper20™

CRACO MFG INC — SmartStud20™

MARINO/WARE, DIV OF WARE INDUSTRIES INC — Viper20™

PHILLIPS MFG CO L L C — Viper20™

2C. **Steel Studs —** (As an alternate to Item 2, For use with Item 4E) Channel shaped, fabricated from min 20 MSG corrosion-protected or galv steel, 3-1/2 in. min depth, spaced a max of 16 in. OC. Studs friction-fit into floor and ceiling runners. Studs to be cut 5/8 to 3/4 in. less than assembly height.

2D. **Framing Members*— Steel Studs —** As an alternate to Items 2 through 2C- For use with Item 1D and 4G only, channel shaped studs, min 3-5/8 in. wide fabricated from min 0.018 in. thick galv steel, spaced a max of 24 in. OC. Studs to be cut 1/2 in. less than assembly height.

CLARKDIETRICH BUILDING SYSTEMS — CD ProSTUD

DMFCWBS L L C — ProSTUD

MBA METAL FRAMING — ProSTUD

RAM SALES L L C — Ram ProSTUD

STEEL STRUCTURAL SYSTEMS L L C — Tri-S ProSTUD

2E. **Framing Members*— Steel Studs —** As an alternate to Items 2 through 2D- For use with Item 1E and 4I only, channel shaped studs, min 3-5/8 in. wide fabricated from min 0.018 in. thick galv steel, spaced a max of 24 in. OC. Studs to be cut 1/2 in. less than assembly height.

TELLING INDUSTRIES L L C — TRUE-STUD™

2F. **Framing Members*— Steel Studs —** As an alternate to Items 2 through 2E- For use with Item 1F, channel shaped studs, min 3-5/8 in. wide fabricated from min 25 MSG steel, spaced a max of 24 in. OC. Studs to be cut 1/2 in. less than assembly height.

KIRII (HONG KONG) LTD — Type KIRII

2G. **Framing Members* - Steel Studs —** Not shown - In lieu of Item 2 through 2F - For use with Item 1G. Proprietary channel shaped studs, minimum 3-5/8 in. wide, Studs to be cut 1/2 in. less than the assembly height.

STUDCO BUILDING SYSTEMS — CROCSTUD

2H. **Framing Members* - Steel Studs —** Not shown - In lieu of Item 2 — For use with Item 1I, proprietary channel shaped steel studs, 1-1/4 in. wide by min 3-5/8 in. deep fabricated from min 0.020 in. thick galv steel. Studs cut 3/4 in. less in length than assembly height.

TELLING INDUSTRIES L L C — Viper20™

2I. **Framing Members* — Steel Studs —** In lieu of Item 2 - For use with Item 1, channel shaped studs, fabricated from min 25 MSG corrosion-protected steel, 3-5/8 in. deep (min), spaced 24 in. OC max. Studs to be cut 3/4 in. less than assembly height.

EB MéTAL INC — EB Stud

2J. **Framing Members* — Steel Studs —** In lieu of Item 2 - For use with Item 1, channel shaped studs, fabricated from min 25 MSG corrosion-protected steel, 3-5/8 in. deep (min), spaced 24 in. OC max. Studs to be cut 3/4 in. less than assembly height.

OLMAR SUPPLY INC — PRIMESTUD

3. **Batts and Blankets* —** (Optional) — Mineral wool or glass fiber batts partially or completely filling stud cavity.

See **Batts and Blankets** (BZJZ) category for names of Classified companies.

3A. **Fiber, Sprayed* —** As an alternate to Batts and Blankets (Item 3) — (100% Borate Formulation) — Spray applied cellulose material. The fiber is applied with water to completely fill the enclosed cavity in accordance with the application instructions supplied with the product with a nominal dry density of 2.7 lb/ft^3. Alternate Application Method: The fiber is applied without water or adhesive at a nominal dry density of 3.5 lb/ft^3, in accordance with the application instructions supplied with the product.

U S GREENFIBER L L C — INS735 & INS745 for use with wet or dry application. INS765LD and INS770LD are to be used for dry application only.

3B. **Fiber, Sprayed* —** As an alternate to Batts and Blankets (Item 3) and Item 3A - Spray applied cellulose insulation material. The fiber is applied with water to interior surfaces in accordance with the application instructions supplied with the product. Applied to completely fill the enclosed cavity. Minimum dry density of 4.3 pounds per cubic ft.

NU-WOOL CO INC — Cellulose Insulation

3C. **Fiber, Sprayed* —** As an alternate to Batts and Blankets (Item 3) - Spray applied cellulose fiber. The fiber is applied with water to completely fill the enclosed cavity in accordance with the application instructions supplied with the product. The minimum dry density shall be 4.30 lbs/ft^3.

INTERNATIONAL CELLULOSE CORP — Celbar-RL

3D. **Batts and Blankets* —** For use with Item 8. Nom 3 in. thick, minimum 3.4 pcf mineral wool batts, friction fit between the studs and floor and ceiling runners.

See **Batts and Blankets** (BZJZ) category for names of manufacturers.

4. **Gypsum Board* —** 5/8 in. thick, 4 ft wide, attached to steel studs and floor and ceiling track with 1 in. long, Type S steel screws spaced 8 in. OC. along edges of board and 12 in. OC in the field of the board. Joints oriented vertically

and staggered on opposite sides of the assembly. When attached to item 6 (resilient channels) or 6A, 6B or 6C (furring channels), gypsum board is screw attached to furring channels with 1 in. long, Type S steel screws spaced 12 in. OC.

ACADIA DRYWALL SUPPLIES LTD — Type X, 5/8 Type X, Type Blueglass Exterior Sheathing

AMERICAN GYPSUM CO — Types AG-C, AGX-1, M-Glass

BEIJING NEW BUILDING MATERIALS PUBLIC LTD CO — Type DBX-1.

CGC INC — Types AR, C, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, WRC or WRX.

CERTAINTEED GYPSUM INC — Types 1, EGRG, GlasRoc, Type X, Type C, SilentFX, 5/8" Easi-Lite Type X.

CONTINENTAL BUILDING PRODUCTS OPERATING CO, L L C — Types LGFC2A, LGFC6A, LGFC-C/A, LGFC-WD, LGLLX.

GEORGIA-PACIFIC GYPSUM L L C — Types 5, 6, 9, C, DAP, DD, DA, DAPC, DGG, DS, GPFS6, LS, , Type X, Veneer Plaster Base - Type X, Water Rated - Type X, Sheathing - Type X, Soffit - Type X, TG-C, GreenGlass Type X, Type X ComfortGuard Sound Deadening Gypsum Board, Type LWX, Veneer Plaster Base-Type LWX, Water Rated-Type LWX, Sheathing Type-LWX, Soffit-Type LWX, Type DGLW, Water Rated-Type DGLW, Sheathing Type- DGLW, Soffit-Type DGLW, Type LW2X, Veneer Plaster Base - Type LW2X, Water Rated - Type LW2X, Sheathing - Type LW2X, Soffit - Type LW2X, Type DGL2W, Water Rated - Type DGL2W, Sheathing - Type DGL2W.

NATIONAL GYPSUM CO — Types eXP-C, FSK, FSK-C, FSK-G, FSMR-C, FSW-C, FSW-G, FSW, FSW-3, FSW-5, FSW-6, FSW-8, FSL.

PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Types PG-C, PG-9, PG-11, PGS-WRS.

PANEL REY S A — Types GREX, PRX, RHX, MDX, ETX.

SIAM GYPSUM INDUSTRY (SARABURI) CO LTD — Type EX-1

THAI GYPSUM PRODUCTS PCL — Type X, Type C.

UNITED STATES GYPSUM CO — Type AR, C, FRX-G, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, WRC, WRX, USGX (Joint tape and compound, Item 5, optional for use with Type USGX).

USG MEXICO S A DE C V — Type AR, C, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, WRC or WRX.

4A. **Gypsum Board* —** (As alternate to Item 4) - Nom 5/8 in. thick gypsum panels with beveled, square or tapered edges, applied vertically or horizontally. Vertical joints centered over studs and staggered one stud cavity on opposite sides of studs. Horizontal edge joints and horizontal butt joints on opposite sides of studs need not be staggered or backed by steel framing. Panels attached to steel studs and floor runner with 1 in. long Type S steel screws spaced 8 in. OC when applied horizontally, or 8 in. OC along vertical and bottom edges and 12 in. OC in the field when panels are applied vertically. When used in widths other than 48 in., gypsum panels to be installed horizontally.

CERTAINTEED GYPSUM INC — Type X, Type C, Type EGRG/ GlasRoc.

CGC INC — Types AR, C, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, WRC or WRX.

CONTINENTAL BUILDING PRODUCTS OPERATING CO, L L C — Type LGFC6A, LGFC-C/A

GEORGIA-PACIFIC GYPSUM L L C — Types DAP, DAPC, DGG, DS.

THAI GYPSUM PRODUCTS PCL — Type X, Type C.

UNITED STATES GYPSUM CO — T ype AR, C, FRX-G, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, WRC, WRX, , USGX (Joint tape and compound, Item 5, optional for use with Type USGX).

USG MEXICO S A DE C V — Type AR, C, IP-AR, IP-X1, IP-X2, IPC-AR, SCX, SHX, WRC or WRX.

4B. **Gypsum Board* —** (As an alternate to Items 4 or 4A) — Nom 3/4 in. thick, 4 ft wide, installed as described in Item 4A with screw length increased to 1-1/4 in.

CGC INC — Types AR, IP-AR.

UNITED STATES GYPSUM CO — Types AR, IP-AR.

USG MEXICO S A DE C V — Types AR, IP-AR.

4C. **Gypsum Board* —** As an alternate to Items 4, 4A, and 4B - Nom. 5/8 in. thick gypsum panels, with square edges, applied horizontally. Gypsum panels fastened to framing with 1 in. long bugle head steel screws spaced a max 8 in. OC, with last 2 screws 3/4 in. and 4 in. from each edge of board. Horizontal joints need not be backed by steel framing. Horizontal edge joints and horizontal butt joints on opposite sides of studs on interior walls need not be staggered or backed by steel framing.

GEORGIA-PACIFIC GYPSUM L L C — GreenGlass Type X.

4D. **Gypsum Board* —** As an alternate to Items 4, 4A, 4B, and 4C - Nom. 5/8 in. thick gypsum panels applied vertically or horizontally. Horizontal edge joints and horizontal butt joints on opposite sides of studs need not be staggered or backed by steel framing. Gypsum panels fastened to framing with 1 in. long Type S steel screws 8 in. OC along vertical edges and 12 in. OC in the field when panels are applied vertically, or 1-1/2 in. from board edges, 3 in. from board edge and every 8 in. OC in the field when applied horizontally. Screws spaced a max 12 in. along the top and bottom edges of the wall.

NATIONAL GYPSUM CO — Types eXP-C, FSK, FSK-C, FSK-G, FSL, FSW-C, FSW-G, FSW, FSW-3, FSW-5, FSW-6, FSW-8, FSMR-C.

4E. **Gypsum Board* —** (As an alternate to Items 4 through 4D) - Installed as described in Item 4. 5/8 in. thick, 4 ft. wide, paper surfaced, applied vertically only and fastened to the studs and plates with 1 in. long, Type S steel screws spaced, 8 in. OC. Not to be used with item 6.

NATIONAL GYPSUM CO — SoundBreak XP Type X Gypsum Board

4F. **Gypsum Board* —** (Not Shown) - (As an alternate to Item 4 when used as the base layer on one or both sides of wall. For direct attachment only to steel studs Item 2C) - Nom 5/8 in. thick lead backed gypsum panels with beveled, square or tapered edges, applied vertically. Vertical joints centered over studs and staggered min 1 stud cavity on opposite sides of studs. Gypsum board secured to studs with 1-1/4 in. long Type S-12 steel screws spaced 8 in. OC at perimeter and 12 in. OC in the field.

RAY-BAR ENGINEERING CORP — Type RB-LBG

4G. **Gypsum Board* —** (As an alternate to Items 4 through 4F) — For use with Items 1D and 2D only, 5/8 in. thick, 4 ft wide, attached to steel studs and floor and ceiling track with 1 in. long, Type S steel screws spaced 8 in. OC. along edges of board and 12 in. OC in the field of the board. Joints oriented vertically and staggered on opposite sides of the assembly.

CONTINENTAL BUILDING PRODUCTS OPERATING CO, L L C — Type LGFC6A, LGFC-C/A

NATIONAL GYPSUM CO — Types FSW

UNITED STATES GYPSUM CO — Type SCX

4H. **Gypsum Board* —** (As an alternate to Items 4 through 4G) — Nominal 5/8 in. thick, 4 ft wide panels, applied

vertically and secured as described in Item 4.

PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type QuietRock ES.

4I. **Gypsum Board* —** (As an alternate to Items 4 through 4F) — For use with Items 1E and 2E only, 5/8 in. thick, 4 ft wide, attached to steel studs and floor and ceiling track with 1 in. long, Type S steel screws spaced 8 in. OC. along edges of board and 12 in. OC in the field of the board. Joints oriented vertically and staggered on opposite sides of the assembly.

UNITED STATES GYPSUM CO — Type SCX

4J. **Gypsum Board* —** (Not Shown) - (As an alternate to Item 4 when used as the base layer on one or both sides of wall. For direct attachment only to steel studs Item 2C) - Nom 5/8 in. thick lead backed gypsum panels with beveled, square or tapered edges, applied vertically. Vertical joints centered over studs and staggered min 1 stud cavity on opposite sides of studs. Gypsum board secured to studs with 1-1/4 in. long Type S-12 steel screws spaced 8 in. OC at perimeter and 12 in. OC in the field. To be used with Lead Batten Strips (see Item 9A) or Lead Discs (see Item 10A).

MAYCO INDUSTRIES INC — Type X-Ray Shielded Gypsum

4K. **Gypsum Board* —** (As an alternate to Item 4 and 4A, not for use with Items 1D, 1E, 2D and 2E) - Nom. 5/8 in. thick gypsum panels with beveled, square or tapered edges installed as described in Item 4 and 4A.

CGC INC — Type ULX

UNITED STATES GYPSUM CO — Type ULX

USG MEXICO S A DE C V — Type ULX

4L. **Gypsum Board* —** (Not Shown) - (As an alternate to Item 4 when used as the base layer on one or both sides of wall. For direct attachment only to steel studs Item 2C). Nom 5/8 in. thick lead backed gypsum panels with beveled, square or tapered edges, applied vertically. Vertical joints centered over studs and staggered min 1 stud cavity on opposite sides of studs. Wallboard secured to studs with 1-1/4 in. long Type S-12 steel screws gypsum panel steel screws spaced 8 in. OC at perimeter and 12 in. OC in the field. Lead batten strips required behind vertical joints of lead backed gypsum wallboard and optional at remaining stud locations. Lead batten strips, min 2 in. wide, max 8 ft long with a max thickness of 0.14 in. placed on the face of studs and attached to the stud with construction adhesive and two 1 in. long Type S-12 pan head steel screws, one at the top of the strip and one at the bottom of the strip. Lead discs, nominal 3/8 in. diam by max 0.085 in. thick. Compression fitted or adhered over the screw heads. Lead batten strips and discs to have a purity of 99.9% meeting the Federal specification QQ-L-201f, Grade "C".

RADIATION PROTECTION PRODUCTS INC — Type RPP - Lead Lined Drywall

4M. **Gypsum Board* —** (For use with Item 8) - 5/8 in. thick, 4 ft wide, applied vertically over Mineral and Fiber Board (Item 8) with vertical joints located anywhere over stud cavities. Secured to mineral and fiber boards with 1-1/2 in. Type G Screws spaced 8 in. OC along edges of each vertical joint and 12 in. OC in intermediate field of the Mineral and Fiber Board (Item 8). Secured to outermost studs and floor and ceiling runners with 2 in. long Type S screws spaced 8 in. OC. Gypsum Board joints covered with paper tape and joint compound. Screw heads covered with joint compound.

AMERICAN GYPSUM CO — Type AG-C

CERTAINTEED GYPSUM INC — Type FRPC, Type C

CGC INC — Types C, IP-X2, IPC-AR

CONTINENTAL BUILDING PRODUCTS OPERATING CO, L L C — Type LGFC-C/A

GEORGIA-PACIFIC GYPSUM L L C — Types 5, DAPC, TG-C

NATIONAL GYPSUM CO — Types eXP-C, FSK-C, FSW-C

PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type PG-C.

PANEL REY S A — Type PRC

THAI GYPSUM PRODUCTS PCL — Type C

UNITED STATES GYPSUM CO — Types C, IP-X2, IPC-AR

USG MEXICO S A DE C V — Types C, IP-X2, IPC-AR

4N. **Wall and Partition Facings and Accessories* —** (As an alternate to Item 4) — Nominal 5/8 in. thick, 4 ft wide panels, applied vertically and secured as described in Item 4.

PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type QuietRock 527.

4O. **Gypsum Board* —** As an alternate to Items 4, 4A, 4B, and 4C - Two layers Nom. 5/16 in. thick gypsum panels applied vertically or horizontally. Horizontal edge joints and horizontal butt joints on opposite sides of studs need not be staggered or backed by steel framing. Horizontal joints on the same side need not be staggered. When applied horizontally, both layers of gypsum board fastened to each side of framing with 1 in. long Type S steel screws spaced 8 in. OC and staggered 4 in. OC between layers. When applied vertically, both layers of gypsum board fastened to each side of framing with 1 in. long Type S steel screws spaced 8 in. OC along vertical edges and 12 in. OC in the field, staggered 4 in. OC between layers. Screws spaced a max 12 in. along the top and bottom edges of the wall.

NATIONAL GYPSUM CO — Type FSW.

5. **Joint Tape and Compound —** Vinyl, dry or premixed joint compound, applied in two coats to joints and screw heads; paper tape, 2 in. wide, embedded in first layer of compound over all joints. As an alternate, nominal 3/32 in. thick gypsum veneer plaster may be applied to the entire surface of Classified veneer baseboard. Joints reinforced. Paper tape and joint compound may be omitted when gypsum boards are supplied with square edges.

6. **Resilient Channel —** (Optional-Not Shown) — 25 MSG galv steel resilient channels spaced vertically max 24 in. OC, flange portion attached to each intersecting stud with 1/2 in. long type S-12 pan head steel screws. May not be used with Item 4F or 4J.

6A. **Steel Framing Members (Not Shown)* —** As an alternate to Item 6, furring channels and resilient sound isolation clip as described below:

a. **Furring Channels —** Formed of No. 25 MSG galv steel. 2-9/16 in. or 2-23/32 in. wide by 7/8 in. deep, spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels are overlapped 6 in. and tied together with double strand of No. 18 SWG galv steel wire near each end of overlap. As an alternate, ends of adjoining channels may be overlapped 6 in. and secured together with two self-tapping No. 6 framing screws, min 7/16 in. long at the midpoint of the overlap, with one screw on each flange of the channel.

b. **Framing Members* —** Used to attach furring channels (Item a) to studs (Item 2). Clips spaced 48 in. OC., and secured to studs with 1-5/8 in. wafer or hex head Type S steel screw through the center grommet. Furring channels are friction fitted into clips. RSIC-1 clip for use with 2-9/16 in. wide furring channels. RSIC-1 (2.75) clip for use with 2-23/32 in. wide furring channels.

PAC INTERNATIONAL INC — Types RSIC-1, RSIC-1 (2.75).

6B. **Framing Members* —** (Not Shown) — (Optional on one or both sides) — As an alternate to Item 6, furring channel and Steel Framing Members as described below:

a. **Furring Channels —** Formed of No. 25 MSG galv steel. 2-3/8 in. wide by 7/8 in. deep, spaced max. 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Gypsum board attached to furring channels as described in Item 4.

b. **Steel Framing Members* —** Used to attach furring channels (Item 6Ba) to studs (Item 2). Clips spaced max. 48 in. OC. GENIECLIPS secured to studs with No. 8 x 1-1/2 in. minimum self-drilling, S-12 steel screw through the center grommet. Furring channels are friction fitted into clips.

PLITEQ INC — Type Genie Clip

6C. **Steel Framing Members —** (Optional, Not Shown)* - Furring channels and resilient sound isolation clip as described below:

a. **Furring Channels —** Formed of No. 25 MSG galv steel. Spaced 24 in. OC perpendicular to studs. Channels secured to studs as described in Item b. Ends of adjoining channels overlapped 6

in. and secured together with four self-tapping No. 8x1/2 Self Drilling screws (2 per side 1 in. and 4 in. from overlap edge). Gypsum board attached to furring channels as described in Item 4. Side joint furring channels shall be attached to studs with RESILMOUNT Sound Isolation Clips - Type A237R located approximately 2 in. from each end of length of channel. Both Gypsum Boards at side joints fastened into channel with screws spaced 8 in. OC, approximately 1/2 in. from joint edge.

b. **Steel Framing Members* —** Resilient sound isolation clip used to attach furring channels (Item 6Ca) to studs. Clips spaced 24 in. OC., and secured to studs with No. 10 x 2-1/2 in. coarse drywall screw through the center hole. Furring channels are friction fitted into clips.

STUDCO BUILDING SYSTEMS — RESILMOUNT Sound Isolation Clips - Type A237R

7. **Wall and Partition Facings and Accessories* —** (Optional, Not shown) — Nominal 1/2 in. thick, 4 ft wide panels, for optional use as an additional layer on one or both sides of the assembly. Panels attached in accordance with manufacturer's recommendations. When the QR-510 panel is installed between the steel framing and the UL Classified gypsum board, the required UL Classified gypsum board layer(s) is/are to be installed as indicated as to fastener type and spacing, except that the required fastener length shall be increased by a minimum of 1/2 in. Not evaluated or intended as a substitute for the required layer(s) of UL Classified Gypsum Board.

PABCO BUILDING PRODUCTS L L C, DBA PABCO GYPSUM — Type QuietRock QR-510.

8. **Mineral and Fiber Board* —** (Optional, Not shown) — For optional use as an additional layer on one side of wall. Nom 1/2 in. thick, 4 ft wide with long dimension parallel and centered over studs. Attached to studs and floor and ceiling runners with 1-5/8 in. long Type S steel screws, spaced 12 in. OC and 24 in. OC along all intermediate framing. The required UL Classified gypsum board layer (Item 4M) is to be installed over the Mineral and Fiber Boards. Batts and Blankets, Item 3D, and Adhesive, Item 11, are required.

HOMASOTE CO — Homasote Type 440-32

9. **Lead Batten Strips —** (Not Shown, For Use With Item 4E) - Lead batten strips, min 1-1/2 in. wide, max 10 ft long with a max thickness of 0.125 in. Strips placed on the interior face of studs and attached from the exterior face of the stud with two 1 in. long Type S-12 pan head steel screws, one at the top of the strip and one at the bottom of the strip. Lead batten strips to have a purity of 99.9% meeting the Federal specification QQ-L-201f, Grade "C". Lead batten strips required behind vertical joints of lead backed gypsum board (Item 4E) and optional at remaining stud locations. Required behind vertical joints.

9A. **Lead Batten Strips —** (Not Shown, for use with Item 4J) Lead batten strips, 2 in. wide, max 10 ft long with a max thickness of 0.140 in. Strips placed on the face of studs and attached to the stud with two min. 1 in. long min. Type S-8 pan head steel screws, one at the top of the strip and one at the bottom of the strip or with one min. 1 in. long min. Type S-8 pan head steel screw at the top of the strip. Lead batten strips to have a purity of 99.5% meeting the Federal specification QQ-L-201f, Grades "B, C or D". Lead batten strips required behind vertical joints of lead backed gypsum wallboard (Item 4J) and optional at remaining stud locations.

10. **Lead Discs or Tabs —** (Not Shown, For Use With Item 4E) - Used in lieu of or in addition to the lead batten strips (Item 8) or optional at other locations - Max 3/4 in. diam by max 0.125 in. thick lead discs compression fitted or adhered over steel screw heads or max 1/2 in. by 1-1/4 in. by max 0.125 in. thick lead tabs placed on gypsum boards (Item 4E) underneath screw locations prior to the installation of the screws. Lead discs or tabs to have a purity of 99.9% meeting the Federal specification QQ-L-201f, Grade "C".

10A. **Lead Discs —** (Not Shown, for use with Item 4J) Max 5/16 in. diam by max 0.140 in. thick lead discs compression fitted or adhered over steel screw heads. Lead discs to have a purity of 99.5% meeting the Federal Specification QQ-L-201f, Grades "B, C or D".

11. **Adhesive —** Not Shown - (For use with Item 8) - Construction grade adhesive applied in vertical, serpentine, nominal 3/8 in. wide beads down the length of both vertical edges of Mineral and Fiber Board (Item 8).

12. **Wall and Partition Facings and Accessories* —** (Optional, Not Shown) — For use with Items 1 to 1I, Items 2 to 2J, Item 3, Items 4 to 4I, Item 5 and Item 6. For maximum fire rating of 1 hour. On one side of the wall, over the first layer of Gypsum Board (Item 4 to Item 4I), install RefleXor membrane with the gold side facing outwards. Membrane installed with T50 staples spaced 12 inches on center in both directions as per manufacturer's instructions, seams in membrane to be overlapped by 2 inches. When RefleXor membrane is used an additional layer of Gypsum Board that is identical to the one used in the first layer and as specified in Item 4 to Item 4I shall be installed over the membrane. The additional layer of Gypsum Board to be installed through the membrane to the stud as specified in Item 4 to Item 4I except the fastener length shall be increased by a minimum of 5/8 inch. Install Batts and Blankets in the stud cavity as per Item 3. On the other side of the wall, prior to the installation of the Gypsum Board, install Resilient Channels as per Item 6. Over the Resilient Channels install ¾ inch thick SONOpan panel secured to the Resilient Channels with drywall screws and washers spaced at 16 in. OC on the perimeter of the panel and 8 in. OC in the field of the panel. Over the SONOpan panel install the same Gypsum Board as specified in Item 4 to Item 4I with the fastener length increased by minimum 3/4 inch. Not evaluated or intended as a substitute for the required layer(s) of UL Classified Gypsum Board.

MSL — RefleXor membrane, SONOpan panel.

*** Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.**

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SECTION 092220 – ACOUSTICAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Provide materials, fabrications and installation of acoustical insulation and associated accessories.

1.2 SUBMITTALS

A. Comply with requirements of Section 013300 – Submittal Procedures.

B. Manufacturer's product data and literature describing each type of insulation.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Insulation shall be certified by the manufacturer to comply with California standards for insulating materials.

2. Insulating materials shall be installed in compliance with Flame Spread Rating and Smoke Density requirements of IBC.

B. Fire Performance Characteristics: Provide insulation materials whose fire performance characteristics have been determined per the ASTM test method indicated below. Identify products with appropriate markings of applicable testing and inspecting organization.

1. Surface Burning Characteristic: ASTM E84

2. Fire Resistance Ratings: ASTM E119

3. Combustion Characteristics: ASTM E136

C. Single Source Responsibility for Insulation Products: Obtain each type of building insulation from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Section 016000 – Product Requirements.

B. Deliver and store packaged materials in original containers bearing identification of manufacturer's name, thermal resistance rating, and fiber materials. Maintain seals unbroken and labels intact until time of use.

C. Keep materials dry by storing off ground under watertight covers.

1.6 PROJECT CONDITIONS

A. Comply with requirements of Section 013100 – Project Management and Coordination.
B. Do not install insulation until construction has progressed to a point that inclement weather will not damage or wet insulation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Acoustical Insulation: Unfaced, friction-fit, flexible sound attenuation batt of fiberglass.

1. Provide thermal resistance rating of R-13 for 3-5/8" and 4" stud wall and R-19 for 6" stud walls, unless otherwise shown.

2. Comply with requirements of ASTM C 665-84, Type I.

3. Manufacturers: Owens-Corning Fiberglass Corp. "Unfaced Fiberglass Insulation, "Schuller- "Unfaced Fiberglass Insulation" or Certainteed Products Corp. "Rigid Fit Unfaced Fiberglass Insulation."

2.2 ACCESSORIES

A. Electrical Box Acoustical Sealer: Resilient sealer pads; "Electrical Box Pads" manufactured by 3M, or approved equivalent.

B. Insulation Support: String wire, staples, nails as required.

C. Stick Fasteners: Rust-resistant metal fasteners and washers adhesively applied to substrate. Stic-Klip Mfg. Co. "Type A or N" with Speed Washers or Miracle Adhesives Corp. "Stuk-Ups, Prong or Spindle and Washer".

D. Adhesive for Stick Fasteners: Type as recommended by fastener manufacturer.

E. Sealing Tape: Type as recommended by the thermal insulation manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive insulation for conditions that will adversely affect installation and performance.

B. Do not start work until defects have been corrected.

C. Coordination: Ensure that all work that will be concealed by the work of this Section, such as electrical and plumbing work, that require inspection, have received all required inspections and been accepted by the inspecting authority.

3.2 INSTALLATION OF INSULATION

A. General Requirements:

1. Comply with insulation manufacturer's instructions applicable to products and application indicated. If printed instructions are not available or do not apply to project conditions, consult manufacturer's technical representative for specific recommendations before proceeding with installation of insulation.

2. Install insulation to fit snugly between framing members and around pipes, conduits, and outlet boxes as necessary to maintain integrity of insulation.

3. Provide means to prevent displacement where required.

B. Acoustical Insulation:

1. Fill spaces between studs with acoustical insulation.

2. Cover rear surface of all recessed mechanical and electrical outlet boxes with outlet box acoustical isolation pad.

3.3 DEFECTIVE WORK

A. Remove any wet insulation or material deemed defective by the Architect, and replace with new material.

B. Restore other work to original condition which was damaged by repair or replacement of defective insulation work.

C. Remove damaged materials from project.

3.4 PROTECTION

A. General: Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes.

B. Provide temporary coverings or enclosures where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 092900 – GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included: Provide and Install gypsum board panels and cementitious panels, complete as shown, including finishing materials and accessories.

1. Interior gypsum board walls, ceilings and soffits:

a. Fire/smoke-rated assemblies.

b. Acoustic assemblies.

c. Water-resistant assemblies.

d. Impact-resistant gypsum board wall assemblies.

e. General wall assemblies, including multi-layer assemblies to facilitate reveals and other decorative features.

f. Cementitious backer board for interior tile assemblies.

2. Interior finishing materials and accessories:

a. Tapes, joint treatments, and coating materials to prepare wall surfaces for painting by others.

b. Corner beads, reveals, and other trims.

c. Neoprene tapes for sealing to work by others.

d. Fasteners, adhesives and sealants.

e. Special trim and accessories.

3. Projectile Resistant Backing: ballistic-proof fiberglass backing for Pharmacy wall assemblies and where shown on Drawings.

B. Work Specified Elsewhere:

1. Section 092216 – Non-Structural Metal Framing.

4. Section 093000 – Tile.

5. Section 072400 – Exterior Insulation and Finish System (EIFS).

6. Section 099123 – Interior Painting.

1.2 SUBMITTALS

A. Comply with requirements of Section 013300 – Submittal Procedures.

B. Provide manufacturers' data describing products and installations.

1.3 QUALITY ASSURANCE

A. Comply with the latest edition of the following standards:

1. American Society for Testing and Materials ASTM C 840, Standard Specification for Application and Finishing of Gypsum Board.

2. Gypsum Association (GA) File Numbers in GA-600 Fire Resistance Design Manual.

B. Fire rated gypsum board systems shall satisfy minimum fire ratings as noted and shall conform to methods approved by applicable Building Code.

C. Tolerances of Installed Trims and Accessories:

1. Horizontal Variation from Level: 1/8-inch in 12 feet.

2. Vertical Variation from Plumb: 1/8-inch in 8 feet.

1.5 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements of Section 016000 – Product Requirements.

B. Deliver materials to the project site with manufacturers' labels intact and legible.

C. Keep materials dry by storing inside building and fully protect from weather.

D. Stack gypsum board neatly and flat, with care to avoid damage to edges, ends and surfaces.

1.6 PROJECT CONDITIONS

A. Environmental Requirements: Establish and maintain application and finishing environment in accordance with ASTM C 840.

B. Provide adequate ventilation to eliminate excessive moisture within building during this work.

PART 2 - PRODUCTS

2.1 MATERIALS - INTERIOR APPLICATIONS

A. Interior Gypsum Board: Use 5/8-inch-thick, Type ‘X’ gypsum board throughout, unless otherwise noted.

1. Typical Finish Board, use throughout unless otherwise noted. ASTM C 36, Type X; tapered, or beveled taper edge, 48 inches wide by maximum length to minimize number of joints.

2. Water-Resistant Gypsum Backing Board: Provide USG's Fiberock Brand "Aqua-Tough"; Georgia-Pacific (GP) "DensShield Tile Guard"; Glass-Mat, Water-Resistant Backing Board through core gypsum board panels per ASTM C 1178, Type FRX-G; tapered, or beveled taper edge, 48 inches wide by maximum length to minimize number of joints.

a. Locations: Use at high humidity/moisture locations, including HSKP rooms, Kitchen and Servery areas.

3. High Abuse, Impact Resistant Board: Provide National Gypsum Hi-Abuse Kal-Kore, USG's Fiberock Brand "Aqua-Tough". 5/8-inch-thick, ASTM C1278, Type X; fiber reinforced gypsum panels; tapered, or beveled taper edge, 48 inches wide by maximum length to minimize number of joints.

a. Gypsum core wall panel with additives to enhance surface indentation resistance, and impact resistance of the core and surface with abrasion-resistant paper on front and long edges with heavy liner paper bonded to the back side and conforming to ASTM C36.

b. Impact Resistance: No failure after 100 impacts when tested in accordance with ASTM E695, modified.

c. Indentation Resistance: Not less than the following loads to produce the indicated depth of the surface indentation when tested in accordance with ASTM D1037, modified:

1) 0.100-inch at 260 pounds.

2) 0.200-inch at 524 pounds.

d. Locations: Typical all corridors from finished floor to 48 inches above finished floor.

4. 1/4-inch Flexible Type: Provide board manufactured to bend to fit tighter radii than specified regular-type gypsum board.

a. Provide only at non-rated curved layouts that exceed maximum allowable bending radii of specified standard thickness gypsum board.

b. Thickness: 1/4 inch. Provide minimum 2 layer application with staggered joints.

c. Long Edges: Tapered.

5. Early-install/Concealed locations (Contractor Option): Provide Georgia Pacific DensGlass Ultra Shaft and DensAmor Plus in conformance with ASTM D 3273; products inherently mold and mildew resistant for use in shaftwalls, concealed locations above finished ceilings, internal layers of multi-layer assemblies and other locations approved by Architect to allow installation before the building enclosure is 100-percent complete.

a. Use at Shaft-side of shaft assemblies and any location where early install is required prior to closing in of the building.

B. Cementitious Backer Board: Per ANSI A108.1; Provide Custom Building Product's "Wonderboard"; USG's "Durock Cement Board". Panels of high-density portland cement surface coating on both faces of lightweight portland cement and

expanded ceramic aggregate core, nominal 5/8-inch-thick and 3.2 to 3.8 pounds per square foot.

1. General: Provide as shown on Drawings for tile assemblies specified in Section 093000 – Tile. (Typical at all toilets/restrooms) At fire-rated wall assemblies and inside faces of exterior walls, apply over gypsum board base layer.

C Acoustically enhanced Gypsum Wallboard Composite:

a. Two-ply high density, mold resistant, paper faced gypsum wallboard laminated together with viscoelastic dampening polymer.
b. Composite Thickness 5/8 inches
c. Fire-resistance, Type X gypsum core
d. Base Product: Quite Rock ES by PABCO Gypsum OR Sound Break XP by National Gypsum Company

D. Interior Joint Finishing Materials:

1. General: Comply with ASTM C 475/C 475M.

2. Joint Tape:

a. Interior Gypsum Wallboard: Paper.

b. Tile Backing Panels: As recommended by panel manufacturer.

3. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

a. Prefilling: At open joints, beveled panel edges, and damaged surface areas, use setting-type taping compound.

b. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping or drying-type, all-purpose compound as recommended by the manufacturer to obtain best results from actual project conditions.

1) Use setting-type compound for installing paper-faced metal trim accessories.

c. Fill Coat: For second coat, use drying-type, all-purpose compound.

d. Finish Coat: For third coat, use drying-type, all-purpose compound.

e. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.

4. Joint Compound for Tile Backing Panels:

a. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.

b. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.

c. Cementitious Backer Units: As recommended by backer unit manufacturer.

E. Fasteners:

1. Screws: ASTM C 954 or ASTM C 1002 self-drilling and self-tapping steel screws with double-lead thread design as approved by system manufacturer for standard and heavier gauge load bearing steel framing.

2. Nails: ASTM C 514, annular ring type as approved by system manufacturer.

3. Staples: Galvanized, as recommended to approved accessory manufacturer.

F. Metal Backing: Refer to Section 092216 – Non-Structural Metal Framing.

G. Metal Accessories: ASTM C 1047 Electro-galvanized steel corner beads and trim (casing beads) formed for application of joint cement and manufactured specifically for gypsum board construction, minimum base steel 0.014 inch thick.

H. Special Trims and Accessories:

1. General: Provide extruded aluminum trims and accessories in conforming to profiles and shapes as shown on Drawings and as specified.

a. Provide double-layer gypsum board assemblies at locations shown on Drawings to receive recessed reveal trims.

b. Material: Extruded aluminum alloy 6063 T5.

c. Manufacturer: Provide products manufactured by Gordon, Fry Reglet Company, Flannery Company, or equal.

a. Accessories: For each trim profile noted below, provide factory fabricated where required by layouts shown on Drawings, including:

1) Mitered assemblies for "T-intersections" and "X-intersections".

2) Finished end caps.

2. Partition "End Cap" Trims: Provide for providing finished ends to gypsum board walls including chemical conversion coating. Typical where gypsum board walls butt mullions of window or window wall assemblies, allowing attachment of partition cap to mullion prior to construction of

gypsum board wall.

a. Overall Width: Provide width matched to partition assembly, including:

1) 4-inch stud walls with 5/8-inch gypsum board each side.

2) 6-inch stud walls with 5/8-inch gypsum board each side.

b. Tape/screw Flanges: Nominal 7/8-inch.

c. Manufacturer: Provide "910 Series" Final Forms by Gordon or equivalent products manufactured by Fry Reglet Company, Flannery Company, or equal.

3. Reveal "Top Track" Trim: Provide for top of wall or partial height partition top cap termination where shown on Drawings.

a. Reveal Depth: Nominal 5/8-inch for use with 5/8-inch gypsum board panels.

b. Reveal Width: As shown on Drawings.

c. Overall Width: Provide width matched to partition assembly, including:

1) 4-inch stud walls with 5/8-inch gypsum board each side.

2) 6-inch stud walls with 5/8-inch gypsum board each side.

d. Tape/screw Flanges: Nominal 7/8-inch.

e. Manufacturer: Provide "922 Series" Final Forms by Gordon or equivalent products manufactured by Fry Reglet Company, Flannery Company, or equal.

4. Reveal "Field" Trims: Provide for creating square-edged vertical and horizontal reveal lines in gypsum board wall assemblies where shown on Drawings.

a. Depth: Nominal 5/8-inch for use with 5/8-inch gypsum board panels.

b. Reveal Width: As shown on Drawings.

c. Tape/crew Flanges: Nominal 7/8-inch.

d. Manufacturer: Provide "500 Series" double-sided Final Forms reveals by Gordon or equivalent products manufactured by Fry Reglet Company, Flannery Company, or equal.

5. Reveal "Edge" Trim: Provide for finished vertical and horizontal reveal edges at top and sides of gypsum board panels where shown on Drawings.

a. Reveal Depth: Nominal 5/8-inch for use with 5/8-inch gypsum board panels.

b. Reveal Width: As shown on Drawings.

c. Tape/screw Flanges: Nominal 7/8-inch.

d. Manufacturer: Provide "200 Series" Final Forms by Gordon or equivalent products manufactured by Fry Reglet Company, Flannery Company, or equal.

6. Reveal "Base" Trim: Provide for recessed base at bottom of gypsum board panels at floor where shown on Drawings.

a. Reveal Depth: Nominal 5/8-inch for use with 5/8-inch gypsum board panels.

b. Reveal Width: 4-inches.

c. Tape/screw Flanges: Nominal 7/8-inch.

d. Manufacturer: Provide "800 Series" Final Forms by Gordon or equivalent products manufactured by Fry Reglet Company, Flannery Company, or equal.

7. Special Fabrications: Provide factory fabricated mitered assemblies for "T-intersections" and "X-intersections" where shown on Drawings.

8. Finish: Special trims to be primed and painted to match adjacent wall surfaces as specified in Section 099123 – Interior Painting.

I. Adhesive for Laminating Board: As recommended by approved board manufacturer.

J. Acoustical Sealant: As specified in Section 079200 – Joint Sealants.

K. Electrical Box Sealer:

a. Non-rated Locations: As specified in Section 079200 – Joint Sealants.

b. Fire-rated Locations: As specified in Section 078413 – Penetration Firestopping.

L. Concealed, Non-Rated Access Panels: As specified in Section 08310 – Access Panels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspect areas and surfaces scheduled to receive gypsum board and verify that:

1. Support systems are in proper alignment, straight and true.

2. Required blocking, bracing and backing members of support systems are installed.

B. Do not start work until unsatisfactory conditions are corrected.

3.2 PREPARATION

A. Coordinate details with other work supporting, adjoining, or fastening to gypsum board.

3.4 INSTALLATION - INTERIOR GYPSUM BOARD

A. General Requirements:

1. Apply and finish gypsum board in accordance with requirements of ASTM C 840 unless otherwise noted.

2. Cut gypsum board by scoring and breaking or sawing from face side. Smooth all cut edges and ends of gypsum board where necessary, in order to obtain neat jointing.

3. Scribe ceiling board neatly in casing bead where it meets surfaces in other planes.

4. Apply first to the ceiling at right angles to framing members, then to walls. Use boards of maximum practical length so that a minimum number of end joints occur.

5. Apply in either vertical or horizontal direction with ends and edges falling on framing members or other solid backing except where edge joints are at right angles to support. Bring ends and edges into contact with adjoining board, but do not force into place.

6. Lay out joints at openings so that no end joint aligns with edges of opening unless control joints will be installed at these points.

a. All joints running parallel to framing shall be centered as near as possible on face of framing member.

b. Stagger end joints and arrange joints on opposite sides of partition to occur on different studs.

c. At external corners, butt and fit board to provide solid edge.

7. Hold gypsum board nominal 1/4-inch above floor or curb typical.

8. Where gypsum board is carried full height to structure above, provide for deflection of structure by undercutting board nominal 3/8 inch and seal top edge of board to structure in continuous bead to form elastic closure.

9. Cut board to fit electrical outlets, pipes, or other items as required.

a. Cut gypsum board by scoring on face and back in outline before removal or by cutting with a saw or other suitable tool.

b. Smooth all cut out where necessary.

10. After trim is applied and prior to decoration, correct surface damage and defects.

11. Provide gypsum backer board gusset at double stud walls where studs are

less than 3-5/8 inches thick.

12. Fastening:

a. Attach board from center to edges and ends, pressing firmly against supports. Place fasteners approximately not more than 1 inch nor less than 3/8 inch from edges with heads just below gypsum board surfaces; but do not break paper.

b. Walls: Space screws maximum 12 inches on center for ceilings and maximum 16 inches on center for walls in field and along abutting edges.

c. Suspended Ceilings: Space screws maximum 12 inches on center in field and along abutting edges.

B. Curved Surfaces:

1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch-long straight sections at ends of curves and tangent to them.

2. 1/4-inch Board Application: For double-layer construction, fasten base layer to studs with screws 16 inches o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches o.c.

a. Continue double layer 1/4-icnh board application to closest adjacent inside or outside corners. Do not "shim" double board to align with adjacent 5/8 thick gypsum board.

3. Fire-rated Assemblies: Provide in strict conformance with referenced UL-listed assembly. Use on standard thickness type "X" board bent per manufacturer's written instructions.

C. Joint Treatment:

1. Apply tape and cement to joints and corners in strict accordance with directions of gypsum board manufacturer.

2. Pre-fill V-grooves formed by the abutting beveled or rounded wrapped edges with joint compound as per manufacturing recommendations.

3. Use tape and cement, allow to dry between coats. Use number of coats required by level of finish specified.

4. Work final coat to smooth level plane surface.

5. Protect external corners with metal corner beads unless otherwise noted.

6. Treat fastening head dimples same as joints; tape may be omitted.

7. Joints and fastening head dimples in backer board need only be treated as required to preserve fire rating.

8. Seal joints shown on Drawings and where gypsum board meets dissimilar material with specified sealant. Tool to neat surface, ready for paint; remove excess material.

D. Fire-Rated Conditions:

1. At penetrations of rated assemblies, preserve continuity of fire rating with firestopping systems as specified in Section 07840 – Firestopping and Smoke Seals.

2. Where adjacent interior spaces have suspended ceilings of different heights, extend separating partition finish on both faces of studs to at least 3 inches above higher ceiling finish.

3. Conform to applicable codes and authorities for requirements of taping and cementing joints and fastener heads.

E. Sound Retardant Partitions:

1. Construct partitions in accordance with Drawings and as herein specified.

2. Hold face layers and base layers 1/4 inch clear from abutting surfaces, floors, walls and overhead structure. Seal with specified sealant and tape. Tape not required at floors.

3. Provide airtight closures at wall penetrations (outlet boxes, pipes, duct work and other items) by neatly cutting gypsum board to clear penetrations. Seal void with specified sealant and apply joint tape to both gypsum board and penetrating object.

4. Seal airtight the backs and sides of electrical junction boxes with resilient sealer pads.

F. Furring over Recessed Light Fixtures: At non-rated lighting fixtures, construct furring from gypsum board as indicated on Drawings.

G. Water-Resistant Board: During board application, coat all cut edges with approved water resistant adhesive as recommended by manufacturer for the application.

H. Enclosure System: Install in strict accordance with requirements of approved manufacturer's system using metal components, gypsum components, and other accessories as required.

I. Cementitious Backer Board:

1. General: Install cementitious backer board in strict conformance with the requirements of the tile assemblies specified in Section 093000 – Tile.

2. Provide support systems so that all edges of cementitious backer boards are supported.

3. Use only corrosion-resistant fasteners.

3.5 FINISHING INTERIOR GYPSUM BOARD ASSEMBLIES

A. Levels of Gypsum Board Finish: Provide the following levels of gypsum board finish per USG "Gypsum Construction Handbook, Centennial Edition".

1. Level 1: for ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistive-rated assemblies and sound-rated assemblies.

2. Level 2: where water-resistant gypsum backing board panels form substrates for tile, and where indicated.

3. Level 3: Not used.

4. Level 4: Not used.

5. **Level 5: Typical, for all gypsum board surfaces unless otherwise indicated.**

B. Level 4 gypsum board finish: Embed tape in joint compound and apply three separate coats of joint compound over joints, angles, fastener heads, and accessories. Touch up and sand between coats and after last coat as needed to produce a surface free of visual defects and ready for decoration. Use the following joint compound combination:

1. Embedding and First Coat: Ready-mixed, drying-type, all-purpose or taping compound.

2. Fill (Second) Coat: Ready-mixed, drying-type, all-purpose or topping compound.

3. Finish (Third) Coat: Ready-mixed, drying-type, all-purpose or topping compound.

C. Where Level 5 gypsum board finish is indicated: apply joint compound combination specified for Level 4 plus a thin, uniform skim coat of joint compound over entire surface.

1. Use joint compound specified for the finish (third coat) or a product specially formulated for this purpose and acceptable to gypsum board manufacturer.

2. Produce surfaces free of tool marks and ridges ready for decoration of type indicated.

D. Where Level 2 gypsum board finish is indicated, apply joint specified for first coat in addition to embedding coat.

E. Where Level 1 gypsum board finish is indicated, apply joint compound specified for embedding coat.

F. Finish water-resistant gypsum backing board forming base for mortar-set ceramic tile to comply with ASTM C 840 and board manufacturer's directions for treatment of joints behind tile.

G. Impact-Resistant Gypsum Board:

1. Construct partitions in accordance with Drawings and as herein specified.

2. General: Install to a height of no less than 4 feet above finish floor at locations shown on Drawings.

3.6 **PARTITION IDENTIFICATION**

A. Identify partitions indicated on drawings as having a required fire or smoke rating.

1. Follow guidelines set in Chapter 7 of International Building Code or as locally amended.
2. Permanently identify with stenciling

   a. Mininum 6 inches high letters with minimum ½ inch stroke.
   b. Bottom of lettering to start at 6 inches above ceiling.
   c. Stenciling to be 10 feet on center max.
   d. Color : Red for 1-hr rated walls, Blue for 2-hr rated walls, Green for smoke partition walls.
   e. Provide in a manner acceptable to authority having jurisdiction.

3.7 CLEANING AND PROTECTION

A. Remedy any fastener popping or ridging.

B. Promptly remove any residual joint compound from adjacent surfaces.

C. Provide final protection and maintain conditions, in a manner suitable to Installer, that ensures gypsum board assemblies remain without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 093000 - TILING

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS**

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

1.2 **SUMMARY**

A. This Section includes the following:

~~1. Ceramic Tile.~~

2. Porcelain Tile.

~~3. Mosaic Tile.~~

B. Related Sections include the following:

1. Division 9 Section "Gypsum Board " for cementitious backer board installed in gypsum wallboard assemblies.

1.3 **DEFINITIONS**

A. Facial Dimension: Nominal tile size as defined in ANSI A137.1.

B. Installation products: ANSI A118

C. Installation procedures ANSI 108

1.4 **SUBMITTALS**

A. Product Data: For each type of tile, mortar, grout, and other products specified.

B. Shop Drawings: Show locations for each type of tile and tile pattern.

C. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples and accessories involving color selection.

1.5 **QUALITY ASSURANCE**

A. Source Limitations for Tile: Obtain all tile of same type and color or finish from one source or producer.

1. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement of ANSI A137.1 for labeling sealed tile packages.

B. Store liquid latexes and emulsion adhesives in unopened containers and protected from freezing.

1.7 **PROJECT CONDITIONS**

A. Environmental Limitations: Do not install tile until construction in spaces is completed and ambient temperature and humidity conditions are being maintained to comply with referenced standards and manufacturer's written instructions.

1.8 **EXTRA MATERIALS**

A. Deliver extra materials to Owner. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size indicated.

PART 2 - PRODUCTS

2.1 **MANUFACTURERS**

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the following manufacturers specified: See finish schedule on drawings.

2.2 **PRODUCTS, GENERAL**

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard Grade requirements, unless otherwise indicated.

B. Colors, Textures, and Patterns: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:

1. Provide Architect's selections from manufacturer's full range of colors, textures, and patterns for products of type indicated. Several colors may be used as indicated on the drawings.

2.3 **TILE PRODUCTS**

A. Manufacturers:

1. Crosville, Inc.

B. Porcelain Floor Tile:

1. Composition: Porcelain Floor Tile
2. Module Size: 12-inches x 12-inches
3. Nominal Thickness: 10.5mm
4. Color: NTR05 – Leading Man, HON

C. Porcelain Wall Tile:

1. Composition: Porcelain stone collection - Notorious
2. Module Size: 12-inches x 24-inches
3. Nominal Thickness: 10.5mm
4. Color: NTR01 – Femme Fatal, UPS
5. Coved Base Tile: 6" x 12" – NTR01.10612CBS, UPS Femme Fatale

2.4 **THRESHOLDS**

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

1. Solid Surface Thresholds: Provide custom quartz thresholds as shown on construction documents.

2.5 **WATERPROOFING:**

A. Waterproof and Crack Isolation Membrane:

1. General: Sheet Membrane: ANSI A118.10; composite sheet membrane made from an alloy of non-plasticized Chlorinated Polyethylene (CPE) with non-woven fiber laminated to both sides.

2. Manufacturer: Noble Company, Product: NobleSeal TS.

B. Performance:

1. 1. Water Vapor Permeance: ASTM E96/E96M, Procedure E; maximum 0.15 perms *(28.6 ng/Pa•s•m²)*.

2. Crack Isolation: "High performance" rating when tested to the "System Crack Resistance" portion of ANSI A118.12.

C. Accessories:

1. Bonding Mortar:
   a. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.

2. Bonding Adhesive: Type recommended by sheet membrane manufacturer to suit application.
   a. Basis of Design Product: NobleBond 21.

3. Mortar Bed:
   a. Portland Cement Mortar (Thickset): ANSI A108.02.

4. Seam Sealant: Type recommended by sheet membrane manufacturer
   a. Basis of Design Product: NobleWeld 150.

5. Perimeter Sealant: Type recommended by sheet membrane manufacturer

2.6 MORTAR MATERIALS - THICK SET BEDS

A. Portland Cement Mortar; Thick-Set: Description: Site mix of Portland cement, sand and water as specified.

B. Portland Cement With Latex Additive; Thick-Set:
   1. Portland Cement: ASTM C150, Type I, from one source only, non-staining and non-air-entraining.
   2. Supplemental cementitious materials derived from coal fired power plant wastes shall not have a mercury content >5.5ppb.
   3. Fly ash shall not be a byproduct of municipal solid waste incinerators
   4. Mortar Sand: ASTM C144, free of deleterious materials, well graded.
   5. Setting Bed Sand: ASTM C136, 100 percent passing No. 4 sieve.
   6. Latex Additive:
      a. Description: Latex additive serving as replacement for gaging water, for use with site mixed portland cement mortar.
      b. Quantity: As recommended by latex additive manufacturer to produce workable consistency.
      c. Acceptable Products:
         1) CustomFloat Bedding Mortar mixed with Acrylic Mortar Admix 1:1 water by Custom Building Products.
         2) 3701 Mortar Admix by Laticrete.
         3) Planicrete 50 by Mapei.

2.7 MORTAR MATERIALS - THIN SET BEDS

C. Portland Cement with Latex Additive; Thin-Set:
   1. Description: Latex additive and site mixed Portland Cement mortar. Complying with ANSI-A118.4.
   2. Quantity: As recommended by latex additive manufacturer.
   3. Acceptable Products:
      a. CustomCrete Latex Mortar Admix with site mixed Mortar or CreteMix Mortar by Custom Building Products.
      b. 4237 Latex Thin set Mortar Additive by Laticrete.
      c. Keracrete System consisting of KER 303 Latex mixed with 1:1 sand/cement blend by Mapei.

4. For all glass tile and glass and stone mixed tile throughout use: Mapei Adesilex P10 bright white grout. Flatten trowel ridges prior to setting glass tiles.

2.8 EPOXY ADHESIVES

D. Multi-component, factory prepared, 100 percent epoxy resin and hardener with sand or mineral filler material.

E. Comply with ANSI A118.3 for thin-set applications for chemical resistant, water cleanable quarry tile installations.

F. Acceptable Products:
1. 100% Solids Epoxy Mortar by Custom Building Products.
2. Latapoxy 300 Epoxy Adhesive by Laticrete.
3. Kerapoxy 410 Chemical Resistant Epoxy Mortar by Mapei.

2.9 GROUT

G. Epoxy Grout for Floor Tile:
1. Multi-component, factory prepared, 100 percent epoxy resin and hardener with sand or mineral filler material.
2. Comply with ANSI A118.3.
3. Color: To be selected.
4. Acceptable Products:
   a. Kerapoxy Chemical Resistant Grout by Mapei.

H. Unsanded Latex – Modified Grout for Wall Tiles
1. Description: Latex modified, factory blended. Mildew resistant, non-sanded consisting of Portland cement and additives: comply with ANSI A118.6
2. Latex Additive: Type as recommended by latex mortar manufacturer.
3. Color: To be selected
4. Acceptable Products:
   a. KER 800 polymer-modified unsanded grout by Mapie

2.11 ELASTOMERIC SEALANTS

a. General: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics required.
b. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated.

1) Products:

a) Bostik; Chem-Calk 550.
b) Mameco International, Inc.; Vulkem 245.
c) Tremco, Inc.; THC-900.

2.12 TILE BACKER BOARD

a. Moisture-resistant treated gypsum core, glass mats both sides, and vinyl, water barrier coating on finished side.
b. Thickness: 5/8 IN.
c. Mold-resistance score: 10 per ASTM D3273.
d. Base Product: DensShield Tile Backer by Georgia Pacific.

e. Include Level 5 finish at non-tiled portions.
f. Optional Products:
   1. Fiberock Interior Panel, Aqua-Tough by USG.
   2. GlasRoc Tile Backer by Certainteed.
g. Tile Backer Board wallboard scheduled in Fire Rated Walls:
   1. Approved fire-resistive products with comparable moisture-resistance.
   2. Base Product: DensShield Fireguard Tile Backer by Georgia Pacific.

2.13 MISCELLANEOUS MATERIALS

h. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
i. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
j. Grout Sealer: Manufacturer's standard product for sealing grout joints that does not change color or appearance of grout. Provide at all grout applications as required by grout manufacturer.
k. Edge protection and transition: for finishing outside edges of tiled wall corners or transitions to another material. Typical at all tile applications.

   1) Schluter Rondec or Jolly as required. Choose from manufacturers full line of colors.

2.13 MIXING MORTARS AND GROUT

a. Use urethane based grout for stone and glass mosaic tiles applications at walls conforming to ISO 13007 R2 and ISO 13007 RG Ensyme resistant formula, respectively.
b. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
c. Add materials, water, and additives in accurate proportions.
d. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 2 - EXECUTION

1. EXAMINATION
   a. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

      1) Verify that substrates for setting tile are firm; dry; clean; free of oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 Series of tile installation standards for installations indicated.
      2) Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
      3) Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

b. Proceed with installation only after unsatisfactory conditions have been corrected.

2. PREPARATION
   a. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.
   b. Provide concrete substrates for tile floors installed with adhesives or thin-set mortar that comply with flatness tolerances specified in referenced ANSI A108 Series of tile installation standards.

      1) Fill cracks, holes, and depressions with trowelable leveling and patching compound according to tile-setting material manufacturer's written instructions. Use product specifically recommended by tile-setting material manufacturer.
      2) Remove protrusions, bumps, and ridges by sanding or grinding.

3. INSTALLATION, GENERAL
   a. ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.
   b. TCA Installation Guidelines: TCA's "Handbook for Ceramic Tile Installation." Comply with TCA installation methods indicated in ceramic tile installation schedules.
   c. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
   d. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
   e. Jointing Pattern: Lay tile in patterns as shown in construction documents. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.
   f. Lay out tile wainscots to next full tile beyond dimensions indicated.
   g. Use crack isolation mat where poured gypsum is used for leveling.
   h. Grout tile to comply with requirements of the following tile installation standards: For ceramic tile grouts (sand-portland cement; dry-set, commercial portland cement; and latex-portland cement grouts), comply with ANSI A108.10. Epoxy/Resin-Based Grout: ISO 13007 RG 100%-solid epoxy grout, with high chemical, stain, and enzymatic.

4. WATERPROOFING INSTALLATION

   a. If membrane is not wide enough, seam by overlapping sheets minimum 2 inches *(50 mm)*, shingle fashion in direction of water drainage. Seal joints watertight.

b. Turn sheet membrane installed on floors up vertical surfaces minimum 18 inches *(50 mm)* higher than flood plane and bond to substrate.
   1) Shower Walls: Extended sheet membrane for the full height of the wall.
c. Extend sheet membrane over floor drains. Cut drain opening in sheet membrane and seal to drain body. Secure membrane with floor drain clamping ring. Seal sheet membrane watertight to items penetrating sheet membrane.
d. Install waterproofing to comply with ANSI A108.13 and waterproofing manufacturer's written instructions to produce waterproof membrane of uniform thickness bonded securely to substrate.
e. Do not install tile over waterproofing until waterproofing has cured and been tested to determine that it is watertight.
f. Flood test waterproof membranes for 72 hours after fully cured

5. WALL TILE INSTALLATION
   a. Install types of tile designated for wall installations to comply with requirements in the Wall Tile Installation Schedule, including those referencing TCA installation methods and ANSI setting-bed standards.
   b. Joint Widths: Install tile on walls with the following joint widths: refer to installation guidelines for grout joint recommendations at each type of tile.

6. CLEANING AND PROTECTING
   a. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
      1) Remove grout residue from tile as soon as possible.
      2) Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
   b. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

END OF SECTION

SECTION 095100 – CEILING SUSPENSION

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included: Provide and install ceiling suspension systems, complete, as shown on Drawings and as specified for the following ceiling finish systems:

1. Gypsum Board Ceilings, coordinated with the Work of Section 09 29 0 – Gypsum Board.

2. Lay-in Acoustical Ceilings, coordinated with the Work of Section 09 51 13 – Acoustical Ceilings.

3. Lay-in Acoustical Ceilings for MRI rooms, including non-ferrous suspension components, coordinated with the Work of Section 09 51 13 – Acoustical Ceilings.

B. Work Specified Elsewhere:

1. Section 01410 – Testing and Inspection Services

2. Section 050500 – Metal Fasteners.

3. Section 083113 – Access Panels.

3. Section 092216 – Non Structural Metal Framing.

4. Section 095113 – Acoustical Ceilings.

5. Divisions 15 and 16 – Mechanical and Electrical Work in Suspended Ceilings.

1.2 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM):

1. C635; Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.

2. C754; Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum.

3. C841; Standard Specification for Installation of Interior Furring and Lathing.

4. C1063; Standard Specification for Installation of Lathing and Furring for Portland Cement-Based Plaster.

5. C636; Standard Specification for Installation of Metal Suspension System for Acoustic Tile and Lay-In Panels.

6. CISCA Ceiling Systems Installation Handbook.

B. International Building Code (IBC) with 2003 Utah Amendments.

1.3 SUBMITTALS

A. Comply with requirements of Section 01330 – Submittal Procedures.

B. Samples:

1. Exposed Suspension System Components: 12-inch-long piece of each item specified.

C. Shop Drawings: Show following:

1. Layout of suspension systems, location of hangers, seismic braces and trapezes, indicating location of fixed and free side of layouts.

2. Hanger spacing and fastening details.

3. Trapeze details.

4. Splicing method for main and cross runners.

5. Support at ceiling fixtures and air diffusers.

6. Change in level details.

7. Locations and dimensions of access panels, light fixtures, supply and exhaust grilles and diffusers, sprinkler heads, speakers, and detection devices.

8. Seismic control details.

9. Develop and coordinate location of all Work which is to be located in ceiling with the Sections involved per Section 01330 – Submittal Procedures prior to making shop drawing submittal.

D. Product Data: Manufacturer's information on materials, fabrication, and installation. Provide certification of flame spread rating and UL classification.

1.4 QUALITY ASSURANCE

A. Allowable Tolerances:

1. Deflection: Do not exceed a maximum of L/360 of span.

2. Level: Do not deviate from level in excess of 1/8 inch in 12 feet.

B. Testing:

1. If required by local authority, special inspection services may be implemented, refer to Section 01410 – Testing and Inspection Services.

2. Fasteners: As specified in Section 05050 – Metal Fasteners.

1.5 PRE-INSTALLATION CONFERENCE

A. Comply with requirements of Section 01315 – Project Meetings.

B. Arrange a conference at the job site to coordinate interior wall, partition and ceiling installation, to be attended by the Owner, Architect, Contractor, and personnel involved in the actual manufacture and installation of the Work of the following Sections:

1. Section 07220 – Acoustical Insulation.

2. Section 07840 – Fire Stopping and Smoke Seals.

3. Section 09110 – Interior Wall Framing.

4. Section 09120 – Ceiling Suspension.

5. Section 09250 – Gypsum Board.

6. Section 09265 – Shaft Wall Systems.

7. Section 09510 – Acoustical Ceilings.

8. DIVISION 15 – Mechanical.

9. DIVISION 16 – Electrical.

1.6 PRODUCT HANDLING

A. Delivery: Deliver products and materials in original unopened packages, containers, or bundles with manufacturer's label intact and legible.

B. Damaged Items: Remove items delivered in broken, damaged, rusted, or unlabeled condition from Project site immediately.

C. Manufacturer's Recommendations: Follow additional delivery, storage, and handling requirements of manufacturer.

1.7 PROJECT CONDITIONS

A. Concealed Work: Ensure that work concealed by suspended ceilings be complete, tested if required, inspected, and approved prior to commencement of installation of materials specified herein.

B. Environmental Conditions: Do not commence installation until area has been closed in, and temperature and humidity conditions are similar to those expected during building occupancy.

C. Wet Work: Complete and cured, prior to commencement of installation of suspended ceilings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Framing:

1. General: Types specified are products of Western Metal Lath Company. Structural characteristics and quality of substitutions shall meet or exceed those of types specified and referenced standards.

2. Main Runners: 1-1/2-inch-deep cold-rolled (0.475 pound/foot) or hot-rolled (1.12 pound/foot) steel channels, galvanized for exterior work and rust-inhibitive coated for interior work.

3. Cross Furring: 3/4-inch-deep cold- or hot-rolled (0.3 pound/foot) steel channels, galvanized for exterior work and rust-inhibitive coated for interior work.

4. Furring Channels: 7/8-inch hat-shaped channels, 25-gauge hot-rolled channel at gypsum board ceilings; rust inhibitive finish.

5. Clips: Galvanized steel, of sizes and shapes shown. 16-gauge, except as otherwise shown.

B. Fasteners:

1. Sheet Metal Screws: To suit channel gauge, as specified in Section 09110 – Metal Support Systems.

2. Expansion Bolts:

a. Tie Wire: Hilti Kwik Bolt HKT 14, Ramset/Red Head TW, or equal, with minimum 1-1/2-inch embedment.

b. Others: As specified in Section 05050 – Metal Fasteners.

3. Powder-Actuated Devices (PAD's):

a. As specified in Section 05050 – Metal Fasteners and as follows:

1) Size: 0.145-inch diameter with 15/16-inch minimum penetration.

2) For Attachment of Ceiling Clips: Hilti DN 27 P8T, or equal.

4. Pop Rivets: 3/16-inch-diameter plated steel.

5. Machine Bolts: ASTM A307, Grade A, regular hexagon head type with ASTM A563, Grade A nuts. 1/4-inch size unless otherwise shown.

C. Hanger, Bracing and Tie Wires:

1. FS QQ-W-461H, Finish 5, Class 1, soft temper or ASTM A 641, Class 1 coating, soft temper.

2. Minimum gauges:

a. Hangers, 8.

b. Diagonal bracing wire, 12.

c. Single-strand tie wire, 16.

d. Double-strand tie wire, 18.

D. Welding Electrodes: AWS, low hydrogen type, as required.

E. Ceiling Clips: "BERC2" Clips in conformance with IBC Seismic category D, E, and F requirements for specified ceiling grid systems.

F. Seismic Brace:

1. General: Provide compression post and four 12-gauge galvanized steel wires splayed at 45 degrees vertically and spaced at 90 degrees horizontally to each other and attached to main runner or grid member with 2-inches of compression post.

2. Wire Attachment: PAD devices not permitted for attachment of brace wires. Fasten bracing wires at each end with not less than 4 tight turns within distance of 1-1/2 inches, except machine made wire turns, where both strands have been deformed or bent in wrapping, need not comply with 1-1/2-inch distance requirement as long as turns are tight as possible and four in number.

G. Compression Posts: Provide compression posts as shown on Drawings and as specified, including:

1. Angle Strut Type: Steel sheet angles or channels, not less than 16-gauge, L/R ratio of 200 maximum.

2. EMT Type: Electrical metallic tubing, diameters shown.

3. Metal Stud Type: 2-inch by 4-inch steel stud, 16-gauge. Attach to main channel with three No. 10 screws. Attach to structure per drawings.

4. Proprietary Type: Use at Contractor's option in lieu of angle strut or EMT types. USG's Donn Series VSA Compression Post, or equivalent, galvanized steel telescoping post with top clip, bulb clip, guide ring, and locking device. Provide size recommended by manufacturer for span.

H. Suspension System for Acoustical Ceilings:

1. General: Provide each component as products of a single manufacturer.

2. Type: Comply with ASTM C 635 Structural Classification as "Heavy Duty" Systems, for direct hung installation with interlocking main runners and cross runners. Roll-formed grid components composed of deuble web hot-dipped galvanized steel.

    a. Structural Classification: UL Certified in compliance with CBC Chapter 16 criteria.

3. Manufacturer: CertainTeed, Armstrong World Industries; USG Interiors, Inc; Chicago Metallic;. Products from CertainTeed are the Basis-of-Design for coordinated suspension components and acoustical ceiling panels.

4. Grid System:

    a. For use with the following acoustic ceiling types: ACP-1, ACP-2, ACP-3 and ACP-4 as specified in Section 09 51 13 – Acoustical Panel Ceilings

    b. Manufacturer: CertainTeed

    c. Type: CertainTeed Classis Stab System, Heavy duty 15/16" Tee System; and 15/16" wall molding; including CertainTeed Seismic Perimeter Clip for seismic categories D, E and F.

    d. Surface Finish: Baked polyester paint. Color: White

5. Typical Perimeter Angles: With matching corner caps and splice pieces; same material as that of exposed suspension system members, 15-gauge with hemmed edge, typical.

    a. Finish: Baked polyester paint. Match adjacent grid system.

7. Slip Joints: MM Systems Corp.'s Series DX-100, or equal, white polyvinyl-chloride flexible extrusion for 1-inch-wide joint.

8. Slotted Angle Spacer: Slotted angles or channels with spring steel diamond points which snap tight to prevent movement of strut.

9. Miscellaneous Accessories: Manufacturer's standard for use with suspension system furnished; furnish as required.

I. Sound Isolation Clips: As specified in Section 09110 – Non-Load Bearing Wall Framing.

J. Miscellaneous: Provide manufacturer's standard miscellaneous items and accessories suitable for use intended and required for complete installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine conditions under which ceiling suspension systems are to be installed. Give notification in writing, of conditions detrimental to proper and timely completion of Work. Proceed only when conditions are satisfactory.

3.2 INSTALLATION

A. Hanger Wires:

1. Spacing:

a. For Gypsum Board, Metal Ceilings, and Acoustical Ceilings: 4-foot centers maximum.

2. Clearance: Not less than 6-inches between hanger wires and unbraced ducts, pipes, and conduit.

3. Attachment to Structure Above: Use wire pigtail embedded in concrete, tie wire type expansion bolt, or PAD with ceiling clip, as appropriate.

4. Hanger Wires: Fasten hanger wires to attachment device at structure above with not less than 3 tight turns within distance of 1-1/2-inches, except machine-made wire turns, where both strands have been deformed or bent in wrapping, need not comply with 1-1/2-inch distance requirement as long as turns are as tight as possible and 3 in number.

5. Wire Size:

a. For Gypsum Board Soffits and Ceilings: 8-gauge.

b. For Acoustical and Metal Panel Ceilings: 12-gauge at inaccessible and 10-gauge at accessible areas.

6. Out-Of-Plumb Wires: Install hanger wires as near plumb as possible. Where hanger wires are more than 1 (horizontal) to 6 (vertical) out of plumb, provide counterbrace wires.

B. Trapezes: Provide trapezes or other supplementary support members at obstructions in order to maintain specified hanger spacing. Provide additional hangers, struts or braces as required at all ceiling breaks, soffits or dis-continuous areas. Counter-balance out-of-plumb wires as specified.

C. Additional Hanger Wires: Provide as required at ceiling breaks, soffits, and discontinuous areas.

D. Gypsum Board Ceiling Suspension System:

1. Runner Channels:

a. Spacing: 4-foot maximum centers.

b. Attachment: Saddle tie with hanger wires at 4-foot maximum centers. Make 2 loops and secure with not less than 3 turns in 1-1/2-inch maximum distance.

c. Splice: Lap and interlock flanges 12 inches minimum and tie near each end with double loops of 16-gauge tie wire.

2. Furring Channels:

a. Spacing: 16-inch maximum centers.

b. Attachment: Saddle tie with 16-gauge tie wire to runner channels and secure with no less than 3 tight turns.

c. Splice: Lap and interlock 8-inches minimum and tie near each end with double loops of 16-gauge tie wire.

E. Acoustical Ceiling Panel and Metal Ceiling Panel suspension system:

1. General: Install per Reference Standards, manufacturer's instructions, and reviewed shop drawings.

2. Main Grid Members:

a. Spacing: 4-foot maximum centers.

b. Attachment: Tie with hanger wire secured with not less than 3 turns in 1-1/2-inch maximum distance.

c. Lighting Fixtures, Air Terminals, and Other Services Less Than 56 Pounds in Weight: Secure with slack hanger wires at two corners.

d. Lighting Fixtures, Air Terminals, and Other Services Greater Than 56 Pounds in Weight: Secure with hanger wires at four corners and as shown on Drawings.

3. Secondary Grid Members:

a. Spacing: 2-foot maximum centers.

b. Attachment: Form 2-foot by 2-foot grid with positive splices.

F. Seismic Restraint:

1. General: Provide as follows for each type suspension system.

2. Spacing:

a. Areas Less Than 96-Square Feet:

1) No Dimension Greater Than 12-Feet: No bracing required.

2) Dimension Greater Than 12-Feet: Provide bracing.

b. Areas Greater Than 96-Square Feet: Provide brace for each 96-square feet or fraction thereof.

c. Maximum Brace Spacing: 8-feet by 12-feet.

d. Maximum Distance From Walls: 1/2-brace spacing in direction perpendicular to plane of wall.

3. Seismic Brace:

a. General: Provide compression post and four 12-gauge galvanized steel wires splayed at 45 degrees vertically and spaced at 90 degrees horizontally to each other and attached to main runner or grid member with 2-inches of compression post.

b. Wire Attachment: Powder-actuated devices not permitted for attachment of brace wires. Fasten bracing wires at each end with not less than 4 tight turns within distance of 1-1/2-inches, except machine made wire turns, where both strands have been deformed or bent in wrapping, need not comply with 1-1/2-inch distance requirement as long as turns are as tight as possible and 4 in number.

l. Access Panels: Frame as required for access panels furnished under Divisions 15 and 16 and specified under Section 08310 –Access Panels.

END OF SECTION

SECTION 095113 – ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included: Provide and install acoustical ceilings panels and accessories, complete, as shown and specified, including:

1. Mineral core acoustical ceiling panels.

B. Work Specified Elsewhere:

1. Section 092216 – Non-Structural Metal Framing.

2. Section 122200 – Curatins and Drapes.

3. Division 23 – Mechanical (Air Supply, Ducts, and Connections).

4. Division 26 – Electrical (Lighting Fixture Attachments).

1.2 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM):

1. C635; Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.

2. C636; Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.

B. Ceiling and Interior System Contractors Association (CISCA):

1. Ceiling Systems Handbook.

1.3 SYSTEM DESCRIPTION

A. Performance Criteria:

1. Fire-Hazard Classification: Provide acoustical ceilings that are identical to those tested for following fire hazard characteristics, per ASTM test method indicated below, by UL or other testing and inspecting organizations acceptable to authorities have jurisdiction. Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.

a. Test Method: ASTM E84.
b. Flame Spread: 25 or less.
c. Smoke Developed: 50 or less.

1.4 SUBMITTALS

A. Comply with requirements of Section 013300 – Submittal Procedures.

B. Product Data: Manufacturer's specifications, data, and installation instructions.

C. Shop Drawings:

1. Coordination Drawings: Reflected ceiling plans drawn accurately to scale and coordinating penetrations and ceiling-mounted items. Show following:

a. Ceiling suspension members.
b. Method of attaching hangers to building structure.
c. Ceiling-mounted items including light fixtures; air outlets and inlets; speakers; sprinkler heads; and special moldings at walls, column penetrations, and other junctures with adjoining construction.

D. Samples:

1. For Initial Selection: Manufacturer's standard sample sets consisting of actual acoustical units or sections of units showing full range of colors, textures, and patterns available for each type of unit indicated.

2. For Verification: 12-inch-square sample of each type of exposed finish specified or selected and of same thickness and material indicated for final unit of Work. Where finishes involve normal color and texture variations, include sample sets showing full range of variations expected.

E. Qualification Data: For firms and persons specified in Quality Assurance article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Architects and Owners, and other information specified.

F. Research Reports: Or evaluation reports of model code organization acceptable to authorities having jurisdiction that show compliance of acoustical ceiling system and components with building code in effect for Project.

G. Product Test Reports: From qualified independent testing agencies that are based on its testing or current products for compliance of acoustical ceiling systems and components with requirements.

1.5 QUALITY ASSURANCE

A. Qualifications of Installer: Engage experienced Installer who has successfully completed acoustical ceilings similar in material, design, and extent to those indicated for Project.

B. Single-Source Responsibility: Obtain each type of acoustical ceiling unit from single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of Work.

C. Coordination of Work: Coordinate layout and installation of acoustical ceiling units and suspension system components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system components (if any), and partition system (if any).

1.7 PRODUCT HANDLING

A. Delivery and Storage: Deliver acoustical ceiling units to Project site in original, unopened packages and store them in fully enclosed space protected against damage from moisture, direct sunlight, surface contamination, and other causes.

B. Handling: Handle acoustical ceiling units carefully to avoid chipping edges or damaging units in any way.

1.8 PROJECT CONDITIONS

A. Storage: Before installing acoustical ceiling units, permit them to reach room temperature and stabilized moisture content.

B. Space Enclosure: Do not install acoustical ceilings until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete, and ambient conditions of temperature and humidity will be continuously maintained at values near those expected for final occupancy.

PART 2 - PRODUCTS

2.1 MINERAL CORE ACOUSTICAL PANELS

A. Manufacturer: Provide products manufactured by Armstrong World Industries; USG; or equal.

1. Basis-of-Design: Armstrong World Industries products are specified as the basis of design.

B. Mineral Core Acoustical Panel Types:

1. Type 1:

a. General: Armstrong Ultima Health Zone (Item # 1935)
b. Size: 24 inches by 24 inches by 3/4-inch-thick.
c. Edge Detail: Square Lay-In.
d. Noise Reduction Coefficient: UL Classified NRC of 0.70 in compliance with ASTM C423.
e. Sound Transmission Class: UL Classified CAC minimum of 38 in compliance with ASTM E1414 or ASTM E413.
f. Light reflectance: 0.86

g. Provide manufacturer's coordinated field and border units, as required by layouts shown on Drawings.
h. Specified grid system: Armstrong's Prelude XL 15/16-inch exposed tee.

2. Type 2:

a. General: Armstrong Ultima Health Zone (Item # 1938)
b. Size: 24 inches by 48 inches by 3/4-inch-thick.
c. Edge Detail: Square Lay-In.
d. Noise Reduction Coefficient: UL Classified NRC of 0.70 in compliance with ASTM C423.
e. Sound Transmission Class: UL Classified CAC minimum of 38 in compliance with ASTM E1414 or ASTM E413.
f. Light reflectance: 0.86
g. Provide manufacturer's coordinated field and border units, as required by layouts shown on Drawings.
h. Specified grid system: Armstrong's Prelude XL 15/16-inch exposed tee.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine substrates and structural framing to which ceiling system attached or abuts, with Installer present, for compliance with requirements specified in this and other sections that affect installation and anchorage of ceiling system. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install acoustical ceiling systems per Reference Standards and manufacturer's instructions.

B. Acoustical Ceiling Tiles:

1. General: Make joints straight and true to line with exposed surfaces flush and level. Tightly butt tiles with corners and arises full and without broken edges.
2. Suspended System:

a. Concealed Grid: Install tile with concealed metal splines in kerfed edges between tiles to form concealed mechanical joints.
b. Edge Units: Install spring steel spacers where supported on edge trim.
c. Access Tile: Install units by concealed saddle and notched hook spline method.
d. Identification Markers: Install one per access tile; locate on tile as directed.

3.3 CLEANING

A. Cleaning: Clean exposed surfaces of acoustical ceiling panels. Comply with manufacturer's instructions for cleaning and touch-up of minor finish damage. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 096519 – RESILIENT FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included: Provide and install resilient flooring, resilient base and accessories, complete as shown on Drawings and as specified, including:

~~1. Luxuary Vinyl Plank~~

2. Homogeneous sheet vinyl, heat welded including integral coved base.

3. Resilient Base.

4. Edge Strips, Reducer Strips and other floor-edge transitions.

5. Cap trim, cove-shaped furring, and accessories for cove base installations.

6. Hot Weld Strips and cold seam materials.

7. Adhesives and other accessory materials as required to provide complete floor assemblies as specified.

B. Work Specified Elsewhere:

1. Section 035300 – Concrete Toppings.

2. Section 087100 – Door Hardware.

3. Section 093000 – Tile.

1.2 REFERENCE STANDARDS

A. Resilient Floor Covering Institute (RFCI).

B. American Society for Testing and Materials (ASTM):

1. ASTM E-1907-98: "Standard Practices for Determining Moisture-Related Acceptability of Concrete Floors to Receive Moisture-Sensitive Finishes".

2. ASTM F-1869-89: "Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride".

1.3 SUBMITTALS

A. Comply with requirements of Section 013300 – Submittal Procedures.

B. General: Schedule submittals as required to provide a minimum of 60-days from flooring materials order day to start of installation.

C. Shop Drawings: Provide seaming diagrams for public spaces including corridors.

D. Samples:

1. Edge, Reducer and Transition Strips: Each specified type and color, 12 inches long.

2. Resilient Tile Flooring: 2 samples, each type and color specified, 12 inches square.

3. Resilient Sheet Flooring: 2 samples, each type and color specified, 12 inches square.

4. Resilient Base: 2 samples each type and color, 12 inches long. None required for black color.

E. Product Data: Manufacturer's specifications, data, and installation instructions.

F. Qualifications: Submit Contractor's and Installer's project lists and specified manufacturer certifications, including project names and addresses and contact names and telephone numbers.

G. Maintenance Manuals: Manufacturer's written maintenance instructions.

1.4 QUALITY ASSURANCE

A. Qualifications of Installer: Minimum of three project installations of extent comparable to proposed Project.

B. Regulatory Requirement: Materials shall have the following flammability ratings, according to NFPA 253:

1. Smoke Density: 45 or less.

2. Critical Radiant Flux: Class I - Minimum 0.45 watts per square centimeter. (Class II - Minimum 0.22 watts per square centimeter.)

C. Slip Resistance: Static coefficient of friction for installed flooring shall be equal to or greater than .06 when measured with a James Machine per ASTM D2047.

1.5 PRODUCT HANDLING

A. Comply with requirements of Section 016000 – Product Requirments.

B. Delivery: Deliver materials to Project site in manufacturer's unopened containers clearly marked with manufacturer's name, brand, size, thickness, grade, color, graining, and design.

C. Storage: Store materials per manufacturer's recommendations and at not less than 70 degrees F for at least 24 hours before installation.

1.6 PROJECT CONDITIONS

A. Environmental Requirements: Maintain temperature in spaces to receive resilient flooring at 70 degrees F minimum at least 48 hours before, during, after installation; thereafter, maintain a 55 degrees F minimum.

PART 2 - PRODUCTS

2.1 GENERAL

A. Basis-of-Design: Tile Products as scheduled on the Drawings provide a "Basis-of–Design" for each scheduled Resilient Flooring Product and have been selected and approved for use by the Owner based manufacturer's samples provided to the Architect, and have been fully coordinated with finish materials specified elsewhere.

B. Resilient Flooring substitution requests will only be considered for acceptance by the Architect when the following conditions are met:

1. Proposed substitution Resilient Flooring meets or exceeds the specified material, construction and performance criteria.

2. Proposed Resilient Flooring substitution visually matches scheduled types for thickness, textures, patterns, color, and reflectance and other surface characteristics as determined by the Architect.

3. Acceptance of a proposed substitution Resilient Flooring by the Architect shall incur no additional cost to the Owner, including costs incurred to re-select adjacent finishes specified elsewhere

as required to coordinate and match substituted Resilient Flooring for color, texture or pattern.

2.2 RESILIENT BASE AND ACCESSORIES

A. Manufacturer: Provide products manufactured by Roppe.

B. Adhesive for Resilient Bases: Waterproof type recommended in writing or supplied directly by base manufacturer.

C. Resilient Base Materials: Thermoplastic Rubber, Type TP- Premium Edge wall base. Finish: Smooth Matte Finish. Corners- Factory pre-formed. Thickness- 1/8"; 4-foot minimum length.

1. Provide colors as scheduled on Drawings and specified and as required to match Architect's samples.

2. Provide manufacturer's standard black at casework bases.

D. Resilient Base Types:

1. Rubber Wall Base by Roppe

a. Color: As scheduled on Drawings.

b. Height: 4-inches.

c. Seal rubber base to resilient flooring with continuous clear silicon sealant.

E. Locations: Provide resilient base at locations shown or scheduled on Drawings, including:

1. Exposed, Sealed and Painted Concrete floors.

2. Floors finished with materials specified in this Section.

3. Plywood.

2.3 HOMOGENEOUS SHEET VINYL FLOORING

A. General: Provide PVC-Free Resilient Sheet Flooring in conformance with ASTM F-1303, Type I, Grade 1, Class B Backing, for types, compositions, and other characteristics indicated.

1. Manufacturer: Provide "**BIOSPEC MD**" by **Mannington** Commercial Flooring.

2. Homogeneous Vinyl Flooring Types:

    a. As scheduled on Drawings.

B. Performance Requirements:

1. Fire Resistance: 450 or less when tested per ASTM E-662/NFPA 258 (Smoke Density). 0.45-watts/cm² or better (Class 1 or better) when tested per ASTM E-648/NFPA 253 (Critical Radiant Flux).

2. Static Load Limit: 750-pounds per square inch or better when tested per ASTM F-970.

3. Slip Resistance: equal or exceed specified requirements.

C. Homogeneous Sheet Vinyl Flooring Accessories:

1. Adhesive: Provide Solvent-free Adhesives recommended by each Homogeneous Sheet Vinyl Flooring Manufacture in writing for use with each type of specified Homogeneous Sheet Vinyl Flooring and for the actual conditions at the project area.

    a. Adhesive Trowel: Use appropriate trowel tooth patterns as recommended by the Adhesive Manufacturer in writing for use with the specified Homogeneous Sheet Vinyl Flooring types.

2. Sub-Floor Primer and Sealer: Provide sub-floor Sealers or Primers where recommended by the Resilient Sheet Flooring Manufacturer(s) in writing where required by the Sub-Floor conditions at the project area at the project area noted during verification of conditions.

3. Welding Rods: For Homogeneous Sheet Vinyl Flooring shown on Drawings or scheduled to receive heat-welded seams, provide 4-mm welding rod as recommended in writing by the manufacturer of each specified type of Flooring. Provide single-sourcing of welding rods and sheet vinyl flooring for each specified type of Resilient Sheet Flooring.

    a. Colors: Provide welding rods to match Architect's samples or as selected by Architect from manufacturer's full range of colors.

4. Homogeneous Sheet Vinyl Flooring Initial Cleaning: Typical at all locations, follow Resilient Sheet Flooring manufacturer's written instructions recommending process and product for each specified type.

a. Finish Sheen: to be Matte.

2.4 ~~LUXURY VINYL PLANK~~

~~A. General: Provide Luxury Vinyl Tiles and Planks in conformance with ASTM F-1700, Class 3, Type B for types, compositions, and other characteristics indicated.~~

~~1. Manufacturer:~~
~~a. Provide 6" x 36" LVP "**NATURE'S PATHS**" by **Mannington** Commercial Flooring.~~

~~2. Luxury Vinyl Plank Types:~~

~~a. As scheduled on Drawings.~~

~~B. Performance Requirements:~~

~~1. Fire Resistance: 450 or less when tested per ASTM E-662/NFPA 258 (Smoke Density). 0.45-watts/cm² or better (Class 1 or better) when tested per ASTM E-648/NFPA 253 (Critical Radiant Flux).~~

~~2. Static Load Limit: 750-pounds per square inch or better when tested per ASTM F-970.~~

~~3. Slip Resistance: equal or exceed specified requirements.~~

~~C. Luxury Vinyl Plank Accessories:~~

~~1. Adhesive: Provide Solvent-free Adhesives recommended by the Luxury Vinyl Plank Manufacturer(s) in writing for use with each type of specified Vinyl Composition Tile and for the conditions at the project area.~~

~~a. Adhesive Trowel: Use appropriate trowel tooth patterns as recommended by the Adhesive Manufacturer in writing for use with the specified Luxury Vinyl Plank types.~~

~~2. Sub-Floor Primer and Sealer: Provide sub-floor Sealers or Primers where recommended by the Luxury Vinyl Plank Manufacturer(s) in writing where required by the Sub-Floor conditions at the project area at the project area noted during verification of conditions.~~

~~3. Luxury Vinyl Plank Sealer: Typical at all locations, provide sealer coat for Luxury Vinyl Plank floors as recommended by each Luxury Vinyl Plank manufacturer in writing for each specified type.~~

~~4. Wax for Luxury Vinyl Plank: not recommended.~~

2.7 MATERIALS FOR COVED BASE AT RESILIENT FLOORS

A. General: Provide materials as required to install cove base at locations shown or scheduled on Drawings. Not all specified resilient sheet flooring types may require cove base; some resilient flooring types may be scheduled to receive several base treatments, including cove base.

B. Materials:

1. Fillet Cove Strips: Provide redwood cove strips as recommended by each specified resilient sheet flooring manufacturer in writing to coordinate with each specified resilient sheet flooring type.

2. Outside Corner for Resilient Sheet Coved Base: Provide the each specified manufacturer's outside pre-molded corner to match each specified resilient sheet flooring type. Provide types and color(s) as scheduled on Drawings and as specified.

3. Cap Strip: Extruded aluminum, clear anodized. Single-source one cap strip type and finish for use through-out entire scope of project. Provide cap strips in the longest length practical to minimize butt joints.

2.8 REDUCER STRIPS, EDGE STRIPS AND TRANSITIONS

A. Manufacturer: Where Manufacturer's standard products are scheduled on Drawings and specified, provide the specific products indicated or materials complying with the requirements set forth in this Section.

B. Adhesive for reducer, edge and transition strips: Waterproof type recommended in writing or supplied directly by base manufacturer.

C. Locations: Provide reducer, edge and transition strips at locations where different floor finishes meet, as required to protect the transition joint and/or provide a gentle transition between floor finishes of differing thicknesses, including:

1. Exposed, Sealed and Painted Concrete floors: to any other floor finish.

2. Section 093000 – Tile: to any floor finish specified in this Section and Section 096813 – Tile Carpeting.

3. Floor finishes specified in this Section:

a. All locations between two different floor finish materials specified in this Section.

b. Between two different floor finish colors of the same material specified in this Section when shown or scheduled on Drawings.

c. Between floor finishes specified in this Section and at transitions to carpet specified in Section 096813 – Tile Carpeting.

D. Manufacturer: Provide reducer, edge and transition strips by Johnsonite, Mercer, or approved equal.

1. Provide reducer, edge and transition strips at all level differences in flooring. Center on door frame where possible.

a. Colors: As selcted by the Architect from the manufacturer's full range of standard colors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine substrates and adjoining construction and conditions under which Work will be installed. Give written notification of deficiencies detrimental to proper or timely installation; do not proceed until corrected.

B. Slab Moisture Test:

1. General: Test substrates to determine acceptable dryness prior to application of resilient flooring. Use ASTM F-1869-89, "Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride", as applicable for the specified flooring as recommended by resilient flooring manufacturer.

2. Slab-Moisture Content Testing: Perform tests at locations not more than 50 feet apart in every direction, but no less than one test per 1000-square feet. Verify the following performance criteria are equaled or exceeded before beginning floor installation:

a. Vapor and moisture barrier shall reduce vapor transmissions from concrete slabs-on-grade and above-grade concrete and metal deck assemblies to 3 pounds or less per 1000-square feet in a 24-hour period when tested per ASTM F-1869-89.

b. Alkalinity: Maximum pH of 10.

3. Contingency for High Moisture Readings: Report all unacceptable test results to Architect.

C. Air-Moisture Content Testing:

1. General: Determine relative humidity of air in rooms to receive resilient flooring, using wet-bulb and dry-bulb sling pyschrometer. Do not install resilient flooring when relative humidity exceeds 45 percent.

D. Adhesion Test:

1. Secure one, three-foot-square piece of each specified type of resilient sheet or 3-foot by 3-foot area of each specified type of tile in each typical area that has passed the specified moisture test, using adhesive(s) as specified and recommended by manufacturer(s).

2. The test pieces shall remain in place for 72 hours.

3. Determine if the adhesive is bonding the material satisfactorily to the surface. Resilient flooring should not be able to be removed without severe deformation, tearing, or destruction of the sample(s).

4. Where there is evidence of unsatisfactory bonding, manufacturer's representative is to be notified in order that they may verify and evaluate the conditions.

5. Notify Architect immediately if, in the opinion of manufacturer's representative, the adhesion test results are unsatisfactory.

6. Remove successful test pieces and adhesive prior to commencing final installation.

3.2 PREPARATION

A. Surface Preparation: Clean substrate of deleterious materials which impair bonding of resilient flooring. Do Work on smooth, even troweled finish. Remove rough areas and protrusions from concrete by griding. Fill cracks, rough areas, and other surface defects with an acceptable plastic filler.

B. Primer/Sealer Coat: Apply primer to concrete surfaces; work well into surfaces; use minimum quantity that will assure complete surface

coverage with a non-absorptive base. Allow primer to thoroughly dry before applying adhesive.

1. Prime coat may be omitted if recommended by resilient flooring manufacturer in writing based on review of the project area. Review the requirements for each specified type of resilient flooring for each project area.

2. Do not combine different specified flooring types under one manufacturer's recommendation.

3.3 INSTALLATION

A. Edge Strips:

1. General: Install in continuous lengths at door openings and other exposed edges of resilient flooring, unless otherwise shown. Install edge strips before applying primer.

2. Metal: Anchor strips solidly to substrate with countersunk non-magnetic stainless steel screws; use lead shields for anchoring into concrete; space screws 1-inch from each end and not more than 9-inch centers at intermediate points.

3. Vinyl: Set in and securely bond to substrates with adhesive per manufacturer's recommendations.

B. Prime Coat: Apply primer to concrete surfaces; work well into surfaces; use minimum quantity that will assure complete surface coverage with a non-absorptive base.

a. Allow primer to thoroughly dry before applying adhesive.

b. Prime coat may be omitted if recommended by resilient flooring manufacturer.

C. Adhesive: Apply to substrate with properly notched steel trowels; allow adhesive to become tacky before applying resilient flooring.

D. Resilient Flooring: Extend flooring, and fit neatly and tightly, into breaks and recesses, against bases, around pipes and penetrations, around permanent casework, equipment, and under-casework recesses.

E. Sheet Material:

1. General: Lay sheet material with minimum number of joints with bottom surface securely bonded to substrate and top surface left smooth, clean, and free from imperfections.

a. Make joints straight, tight, and inconspicuous.

b. Roll each sheet from center to edges to assure complete bond and tight joints.

2. Joints: Provide Chemically Weld; Adhesive Weld; Heat Weld as scheduled on Drawings and in conformance with sheet flooring manufacturer's written instructions.

3. Distanace between seams to be eight feet minimum. Provide shop drawings showing seam locations for approval before installation.

4. Coved Bases:

a. Install a continuous redwood cove strip at intersection of floor and vertical surfaces prior to laying sheet material.

b. Use cove strip with a 3/4-inch radius; make bases 4 inches high, unless otherwise shown; butt ends; miter corner; secure with acceptable type fasteners.

c. Apply cove strips and sheet material to solid backing.

d. Roll sheet material into adhesive; hold in place until complete adhesion is assured. **DO NOT USE DOUBLE STICK TAPE FOR THIS APPLICATION. BASE TO BE FULLY ADHERED TO WALL WITH GLUE TYPE ADHESIVE.**

e. Make top of base level and straight; terminate top edge into a metal trim cap.

f. Securely screw trim cap to backing before applying sheet material; use single lengths where possible; make neat mitered corners and butted ends.

g. Use standard aluminum alloy or stainless steel trim cap of standard design as selected, unless otherwise shown.

4. Perimeter Bond System: At Contractor's option, a perimeter bond system may be used for installation of sheet vinyl flooring.

a. Do work with manufacturer's approved and trained applicators per manufacturer's recommendations and supervision.

b. Install sheet vinyl flooring with adhesive spread only at seam lines, projections, and wall lines.

c. Cut seams with an electrically operated cutting machine made for purpose.

F. Resilient Bases:

1. General: Where base is scheduled, install around perimeter of room or space, at base of partitions, walls, columns, pilasters, casework, and other permanent fixtures.

a. Install top-set coved type bases throughout, except install straight type bases at carpet.
b. Secure bases to surfaces with waterproof adhesive; make joints tight; keep top and bottom edges in firm contact with adjacent surfaces.

1) Provide a continuous seal of the resilient base to both the wall surface at the upper edge and the floor surface at the bootom edge.

c. Use longest lengths possible; straight pieces less than 24 inches long not permitted.

d. Miter or cope inside corners.

2. Coved Type: Provide with premolded end stops and premolded one-piece external corners.

3. Straight Type: Provide with preformed one-piece external corners.

4. Edges and Seams: Match edges at seams. Double cut adjoining lengths. Make tight butt joints.

3.4 CLEANING

A. General: Not more than four days before Substantial Completion, thoroughly clean work per resilient flooring manufacturer's recommendations. Use of solvents, wet mopping, or washing is prohibited.

B. Defective and Damaged Work: Replace with acceptable Work at no additional cost to Owner.

3.5 PROTECTION

A. General: Protect Work from traffic during construction period so Work will be without indication of use or damage at time of Substantial Completion.

SECTION 099123- INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included: Interior and Exterior Painting, complete as shown on Drawings and as specified.

1. Work includes, but is not limited to, painting of following items, materials, and spaces:

a. Paint every interior and exterior exposed-to-view unfinished surface, except as otherwise shown on Drawings or as specified.

b. Paint the following exposed mechanical and electrical items to match adjacent surfaces even if the items are factory-finished:

1) Wall and ceiling diffusers/registers installed in gypsum board assemblies at any location.

2) Access doors at any location except when concealed above suspended ceilings.

3) Flush-mounted electrical panelboards and cabinets in gypsum board assemblies at any location.

4) All exposed piping, conduit, duct work and similar surfaces in Stair Enclosures and Fire Control Room (except items with factory "red" finish).

c. Paint semi-visible areas behind registers, grilles, diffusers, screen vents as required to "black out".

d. Paint auxiliary rails of smoke containment screens with high-temperature coating.

e. Stairs: Paint all exposed ferrous metal assemblies, concrete landings and treads, including hazard striping as required by code.

f. Stenciling at Smoke Partition and Fire Rated Walls: See section 092900 Gypsum Board.

2. Do not paint the following items:

a. Factory-finished items specified in various Sections.

b. Pre-finished wall, ceiling, and floor coverings.

c. Concrete traffic or walking decks, walks, steps, and ramps.

d. Code-Required Labels: Keep equipment identification and fire rating labels free of paint.

e. Surfaces concealed in walls and above ceilings except as specifically indicated otherwise.

f. Ducts, piping, conduit, and equipment concealed in walls and ceilings, unless specifically indicated otherwise.

g. Do not paint "Shell Areas" as shown on drawings except paint all sides of doors and frames at walls into finished areas.

h. Mechanical or elevator shafts not requiring periodic cleaning.

i. Mechanically-finished nonferrous metal, such as stainless steel, aluminum, and bronze, except exposed mechanical and electrical items.

j. Interior spaces specifically noted as unpainted.

3. Note: This Section includes a comprehensive listing of paint finish types. Not all paint systems included herein may be required by the Scope of Work of this Project, or the scope of some finishes may be very limited. The responsibility of the Contractor to schedule the Work so that all specified and required Painting Scope is included in the Scope of Work for the Project.

B. Work Specified Elsewhere:

1. Section 050500 – Metal Fasteners.

2. Section 079200 – Joint Sealants.

3. Section 099113 – Exterior Painting.

1.2 SUBMITTALS

A. Comply with requirements of Section 013300 – Submittal Procedures.

B. Product Data: Submit complete list of materials proposed for use, together with manufacturer's data and specifications.

C. Samples:

1. Opaque Colors and Finishes: Submit samples, on hardboard, using materials accepted for Project, of each color and paint finish selected with texture to simulate actual conditions. Prepare three samples, 8-1/2 inches by 11 inches, with required number of paint coats clearly visible.

2. Transparent and Stained Finishes: Prepare samples on species and quality of wood to be used in the Work. Re-submit as requested until acceptable sheen, color, and texture are achieved. Label and identify each sample as to location and application.

1.3 QUALITY ASSURANCE

A. Labeling: Include following on label of each container:

1. Manufacturer's name and product name.

2. Generic type of paint.

3. Manufacturer's stock number.

4. Color.

5. Instructions for reducing, where applicable.

B. Special Requirements of Regulatory Agencies: Use materials for Work of this Section which comply with volatile organic compound limitations and other regulations of local Air Quality Management District and other local, state, and federal agencies having jurisdiction.

C. Project Mock-Up: As directed by the Architect, apply on actual wall surfaces where designated, samples of each and any color selected for final review.

1. On at least 100 square feet of surface as directed, provide full-coat finish samples until required sheen, color and texture are obtained.

2. Duplicate painted finishes of prepared samples.

3. Simulate finished lighting conditions for review of in-place work.

1.4 PRODUCT HANDLING

A. Comply with requirements of Section 016000 – Product Requirements.

B. Delivery: Deliver material in sealed containers with labels legible and intact.

C. Storage of Materials:

1. Store only acceptable Project materials on Project site.

2. Store in suitable location.

3. Restrict storage to paint materials and related equipment.

4. Comply with health and fire regulations.

1.5 PROJECT CONDITIONS

A. Environmental Requirements:

1. Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating systems can be stored and applied.

2. Do not apply finish in areas where dust is being generated.

B. Protection: Cover or otherwise protect finished work of other trades and surfaces not being painted concurrently or not to be painted.

1.6 SCHEDULING

A. Gypsum Board: Verify that a fully-cured skim cooat has been applied to Gypsum Board specified for Level 5 finish and scheduled to receive semi-gloss or gloss paint finishes. Do not proceed until completed.

1.7 MAINTENANCE

A. Extra Materials: At completion of Work, deliver to Owner extra stock of paint of one gallon of each color used of each coating material used. Tightly seal and clearly label containers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Primers and Single-color Paints: Provide paint systems as manufactured by Sherwin-Williams Co. Unless otherwise specified, single source all components of a paint system from a single manufacturer, including primer/sealer/undercoat and body and finish coats to assure compatibility.

1. Sherwin-Williams Co. (S/W).

2.2 MATERIALS

A. General: Provide materials selected for coating system for each type of surface which are the product of single manufacturer.

B. Thinner: As recommended by each manufacturer for his respective product.

C. Unsuitability of Specified Products: Claims concerning unsuitability of any materials specified will not be entertained, unless such claim is made in writing to the Architect before Work is started.

2.3 COLORS

A. Color and Sheen: Colors are scheduled on Drawings (or as selected by Architect if not scheduled on Drawings) based on standard color chips provided by one or more of the listed manufacturers.

B. Mixing: Deliver paints and stains ready mixed to Project site.

2.4 MILDEW RESISTANCE

A. General: Add fungicidal agent to paint per manufacturer's recommendations. Add agent to paint at factory. Clearly indicate on labels that paint is mildew resistant.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine surfaces scheduled to receive paint and finishes for conditions that might adversely affect execution, permanence, or quality of work and which cannot be put into acceptable condition through preparatory work. Proceed with preparation or coating application only when conditions are satisfactory.

B. Review all questions regarding the scope of painting with Owner prior to proceeding with Work.

3.2 SURFACE PREPARATION

A. General: Remove scale, dirt, dust, grit, rust, wax, grease, efflorescence, loose material, and other foreign matter detrimental to proper adhesion of paint.

B. Gypsum Board:

1. Narrow, Shallow Cracks and Small Holes: Fill with spackling compound.

2. Deep, Wide Cracks and Deep Holes: Rake out, dampen with clear water, and fill with thin layers of gypsum board joint compound.

3. Curing: Allow to dry.

4. Sanding: Sand smooth after drying; do not raise nap of paper on gypsum board.

C. Metals:

1. Chipped or Abraded Areas in Shop Coatings: Touch-up using appropriate primer.

2. Galvanized Surfaces: Apply a wash coat made by dissolving 8 ounces copper acetate or copper sulfate in one gallon of water; apply with brush.

3. Stainless Steel: Scarify surfaces before applying prime coat.

D. Wood:

1. General: If required, sandpaper surfaces smooth before applying primer. Thoroughly clean knots; apply thin coat of knot sealer over surfaces shown to receive opaque finish.

2. Back Priming: Back prime surfaces installed against cementitious surfaces; give particular attention to sealing cross-grained surfaces.

3. Puttying:

a. General: Fill nail holes, cracks, and other depressions flush with putty after prime coat application. Allow putty to dry; sandpaper smooth before applying body coat.

b. For Opaque Finish: Linseed oil type putty.

E. Protection:

1. General: Properly protect floors and other adjacent work by drop cloths or other suitable coverings. In areas scheduled for painting, maintain wrappings and factory-applied protection provided by other trades.

2. Hardware and Other Obstructions: Remove or protect factory finished items such as hardware, plates, lighting fixtures, grilles, and similar items placed prior to painting. Reposition or remove protection upon completion of each space. Equipment adjacent to surfaces requiring paint disconnected, moved, reset, and reconnected by respective trades.

3. Fire Precautions: At end of each work day, place in metal containers or remove from premises, solvent soaked cloths, waste, and other materials which constitute a fire hazard.

F. Moisture Content: Do not apply initial coating until moisture content of surface is within limitations recommended by paint manufacturer.

3.3 APPLICATION

A. General: Apply paint per manufacturer's instructions and as specified. Thoroughly stir paint and keep at uniform consistency during application. Apply paint evenly, free from drops, ridges, waves, laps, and brush marks; finished surface uniform in sheen, color, and texture. Apply succeeding coats to unscarred and completely integral base coats; slightly vary color of undercoats to distinguish them from preceding coat. Allow sufficient time between coats to assure proper drying. Sandpaper smooth interior finishes between coats.

B. Prime Coat: Do not thin primers in excess of manufacturer's printed directions. Apply by brush, unless otherwise specified, within 8 hours after cleaning.

C. Body and Finish Coats: Do not thin; apply by brush, roller or spray.

D. Drying Time: Comply with recommendations of product manufacturer for drying time between succeeding coats.

E. Moldings and Ornaments: Leave clean and true to details with no undue amount of paint in corners and depressions.

F. Edges of Paint: Where adjoining other materials or colors, make clean and sharp with no overlapping.

G. Refinishing: Refinish entire wall where portion of finish is deemed not acceptable.

H. Precaution: Do not paint over fusible links, UL labels, or sprinkler heads.

I. Exposed Plumbing and Mechanical Items: Finish items without factory finish such as conduits, pipes, access panels, and items of similar nature to match adjacent wall and ceiling surfaces, unless otherwise directed.

3.4 CLEANING

A. General: Touch up and restore finish where damaged. Remove spilled, splashed, or spattered paint from surfaces. Do not mar surface finish of item being cleaned.

B. Storage Space: Leave clean and in condition required for equivalent spaces in Project.

3.5 PAINT SYSTEMS

A. Schedule: Only major areas are scheduled. Treat miscellaneous and similar items and areas within room or space with similar system.

B. Number of Coats: Where number of coats are specified, it is only as a minimum requirement. Apply additional coats, at no additional cost to Owner, if necessary to completely hide base material, produce uniform color, and provide satisfactory finish result.

C. Thickness of Coats: For each paint system product, provide the manufacturer's recommended mil-thickness for each applied coat.

D. Systems Specifications: These specifications are a guide and are meant to establish procedure and quality. Confer with Architect to determine exact finish desired.

E. Acceptance of Final Colors: Do not apply final coats of paint for either exterior and interior systems until colors have been reviewed and accepted by the Architect.

3.6 INTERIOR PAINT SYSTEMS (Systems are based on products by S-W; other manufacturers listed in Part Two may be used)

A. Interior Gypsum Board – Flat:

1. General: Provide as follows unless otherwise scheduled on Drawings or noted as follows in this Section.
2. Flat Finish — Low Odor Zero VOC System
3. Primer: ProMar 200 Zero VOC Interior Latex Primer, B28W2600, 0 g/L VOC
4. 1st coat: ProMar 200 Zero VOC Flat, B30-2600 series, 0 g/L VOC
5. 2nd coat: ProMar 200 Zero VOC Flat, B30-2600 series, 0 g/L VOC

B. Interior Gypsum Board – Eggshell/Satin:

1. General: Provide as follows unless otherwise scheduled on Drawings or noted as follows in this Section.
2. Primer: ProMar 200 Zero VOC Interior Latex Primer, B28W2600 0 g/L VOC
3. 1st coat: ProMar 200 Zero VOC Eg-Shel B26-2600 series, 0 g/L VOC
4. 2nd coat: ProMar 200 Zero VOC Eg-Shel B26-2600 series, 0 g/L VOC

C. Interior Gypsum Board – Semi-gloss:

1. General: Provide at stairs, service areas and where scheduled.
2. Primer: ProMar 200 Zero VOC Interior Latex Primer, B28W2600, 0 g/L VOC
3. 1st coat: ProMar 200 Zero VOC Semi-Gloss B31-2600 series, 0 g/L VOC
4. 2nd coat: ProMar 200 Zero VOC Semi-Gloss B31-2600 series, 0 g/L VOC

D. Interior Gypsum Board – Epoxy Coatings:

1. General: Provide at Restroom and other gypsum surfaces as scheduled on Drawings and required by the the governing Health Codes:
2. Eg-Shel Finish
    a. Primer: ProMar 200 Zero VOC Primer, B28W2600, 0 g/L VOC
    b. 1st coat: Pro Industrial Pre-Catalyzed Water-Based Epoxy Eg-Shel, K45 series, <150 g/L VOC
    c. 2nd coat: Pro Industrial Pre-Catalyzed Water-Based Epoxy Eg-Shel, K45 series, <150 g/L VOC
3. Semi-Gloss Finish (typical, unless noted otherwise)
    a. Primer: ProMar 200 Zero VOC Primer, B28W2600, 0 g/L VOC
    b. 1st coat: Pro Industrial Pre-Catalyzed Water-Based Epoxy Semi-Gloss, K46 series, <150 g/L VOC
    c. 2nd coat: Pro Industrial Pre-Catalyzed Water-Based Epoxy Semi-Gloss, K46 series, <150 g/L VOC
4. Gloss Finish
    a. Primer: ProMar 200 Zero VOC Primer, B28W2600, 0 g/L VOC
    b. 1st coat: Pro Industrial Zero VOC Water-Based Epoxy Gloss, B73-300 series, 0 g/L VOC

c. 2nd coat: Pro Industrial Zero VOC Water-Based Epoxy Gloss, B73-300 series, 0 g/L VOC

E. Interior Ferrous Metal:

1. General: Shop and field-applied paint finishes for the Work of Section 050500 – Metal Fabrications, is included in the Scope of Work for those Sections.

2. For other exposed-to-view ferrous metal items, including items specified in DIVISION 23 – Mechanical; and DIVISION 26 – Electrical, provide the finishes as follow:

3. Bare Metal Items; High Performance Coating System: Mechanical and Electrical Piping, Conduits, Ductwork, Supports, Hangers, Machinery and Similar Items:
   a. Eg-Shel or Gloss Finish (Verify with Architect for each room / area prior to painting)
   b. Primer: Pro Industrial Pro-Cryl Universal Primer, B66-310 series, <100 g/L VOC
   c. 1st coat: Pro Industrial Zero VOC Water-Based Epoxy Eg-Shel, B73-360 series or Gloss, B73-300 series, 0 g/L VOC
   d. 2nd coat: Pro Industrial Zero VOC Water-Based Epoxy Eg-Shel, B73-360 series or Gloss, B73-300 series, 0 g/L VOC

4. Shop Primed or painted (by others) Items; Semi-Gloss finish:
   a. Primer: Pro Industrial Pro-Cryl Universal Primer, B66-310 series, <100 g/L VOC
   b. 1st coat: Pro Industrial Zero VOC Acrylic Semi-Gloss, B66-650 series, 0 g/L VOC
   c. 2nd coat: Pro Industrial Zero VOC Acrylic Semi-Gloss, B66-650 series, 0 g/L VOC

5. Shop Galvanized Items:

   a. Galvanizing repair provided in Section 050500 – Metal Fabrications.
   b. Galvanized Metal Decking & Ferrous Decking — Including Bar Joists
      i. Flat, Eg-Shel, or Semi-Gloss Finish
      ii. Primer: Pro Industrial Pro-Cryl Universal Primer, B66-310 series, <100 g/L VOC
      iii. 1st coat: Low VOC Waterborne Acrylic Dryfall, Flat B42W81, Eg-Shel B42W82, Semi-Gloss, B42W83, All sheens <50 g/L VOC
      iv. 2nd coat: Low VOC Waterborne Acrylic Dryfall, Flat B42W81, Eg-Shel B42W82, Semi-Gloss, B42W83, All sheens <50 g/L VOC
   c. Galvanized Metal Decking & Ferrous Decking — Including Bar Joists – High Performance System

i. Primer: Pro Industrial Pro-Cryl Universal Primer, B66-310 series, <100 g/L VOC
ii. 1st coat: Pro Industrial Multi-Surface Acrylic Eg-Shel, B66-560 series, <150 g/L VOC
iii. 2nd coat: Pro Industrial Multi-Surface Acrylic Eg-Shel, B66-560 series, <150 g/L VOC

F. Interior Aluminum and Copper:

1. Refer to Section 076200 – Flashing and Sheet Metal for shop and field-applied paint finishes specified in those Sections.

2. Mechanical and Electrical Items:
   a. Pretreatment: Metal Pretreatment.
   b. 1st Coat: Aluminum Primer. Provide additional general purpose sealer coat when recommended by paint manufacturer.
   c. 2nd Coat: Acrylic Paint, Semi-Gloss.
   d. 3rd Coat: Acrylic Paint, Semi-Gloss.

G. Interior Wood:

1. General: Transparant Finishes are specified and provided in Section 064123 Interior Architectural Woodwork
2. Semi-Gloss Finish — Low Odor Zero VOC System
3. Primer: ProMar 200 Zero VOC Primer, B28W2600, 0 g/L VOC
4. 1st coat: Pro Industrial Zero VOC Acrylic Semi-Gloss, B66-650 series, 0 g/L VOC
5. 2nd coat: Pro Industrial Zero VOC Acrylic Semi-Gloss, B66-650 series, 0 g/L VOC

H. Interior Mechanical Insulation; Finish Varies:

1. Provide finish materials recommended in writing by the mechanical insulation manufacturer for their products in exterior locations. Adapt the following as required.

   a. 1st Coat: General Purpose PVA Sealer, or as recommended by the insulation manufacturer.

   b. 2nd Coat: Match adjacent finish system.

I. Miscellaneous Interior Painting Systems:

1. Ductwork at Grilles and Diffusers:

   a. Apply interior surfaces of ductwork partially visible through grilles and diffusers.

   b. 1st Coat: Galvanized Metal Primer.

c. 2nd Coat: Acrylic Paint, Matte Black.

d. 3rd Coat: Acrylic Paint, Matte Black.

2. Exposed Insulated Pipes and Ductwork:

a. 1st Coat: 1 coat General Purpose PVA sealer. Omit sealer where glass fabric jackets are used.

b. 2nd Coat: Acrylic Paint, match adjacent finish.

c. 3rd Coat: Acrylic Paint, match adjacent finish.

3. Exposed Non-Insulated Pipes and Ductwork: Including conduit.

a. Cast-Iron Pipe:

1) Pre-treatment: Conform with the requirements of Section 050500 – Metal Fabrications.

2) 1st Coat: Ferrous Metal Primer.

3) 2nd Coat: Acrylic Paint, match adjacent finish.

4) 3rd Coat: Acrylic Paint, match adjacent finish.

b. Other Pipes, Conduit, and Ductwork:

1) Pre-treatment: Conform with the requirements of Section 050500 – Metal Fabrications.

2) 1st Coat: As specified for ferrous and non-ferrous metals as applicable.

3) 2nd Coat: Acrylic Paint, match adjacent finish.

4) 3rd Coat: Acrylic Paint, match adjacent finish.

J. Miscellaneous Interior Painting Systems:

1. Factory Finished Equipment: Satisfactorily refinish surfaces damaged before, during, or after installation as directed; use 128 semi-gloss enamel.

2. Plywood Equipment Backing:

a. General: Telephone, Data and Electric Closets.

b. 1st Coat: Latex Enamel Undercoater.

c. 2nd Coat: Acrylic Paint; match adjacent finish.

d. 3rd Coat: Acrylic Paint; match adjacent finish.

K. Pipe Identification:

1. General: Per ANSI A13.1; buried pipe, electrical conduit, and pipe in concealed spaces such as furred spaces and shafts not included.

2. Color Scheme: ANSI Z53.1 in combination with legend and flow markers; continuous total length coverage. Safety colors as specified under applicable Mechanical Section.

3. Legend: Stencil letters of colors, type, and sizes per ANSI A13.1. Tags for identification of pipes less than 3/4-inch overall outside diameter, including valves and fittings; provided under applicable mechanical Section.

4. Flow Markers: Provide each type with appropriate size arrows to indicate flow direction in pipe; same color as legend.

5. Visibility: Locate legend and flowmarkers for easy visibility from operating floor; space not over 20 feet with at least one per room.

3.8 CLEANING:

A. Comply with provisions of Section 017900 – Cleaning.

B. Remove paint spots, oil, and stains from adjacent surfaces upon completion of Work; leave Work clean.

END OF SECTION

SECTION 102600 – WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included: Provide and install wall protection, wall corner guards and other finish protection products, complete, as shown on Drawings and as specified, including:

1. Surface-Mounted Corner Guards and Partition End Guards.

2. Protective Wall Covering Wainscot

3. Crash Rails

B. Work Specified Elsewhere:

1. Section 081113 – Hollow Metal Doors and Frames.

2. Section 084113 – Aluminum Entrances and Storefronts.

3. Section 081416 – Flush Wood Doors.

4. Section 079200 – Joint Sealants.

5. Section 087100 – Door Hardware

6. Section 092216 – Non-Structural Metal Framing.

1.2 SUBMITTALS

A. Comply with provisions of Section 013300 – Submittal Procedures.

B. Product Data: Manufacturer's catalog cuts, standard color charts, and data sheets; including installation details and instructions, for each item specified.

C. Samples:

1. Crash Rails: 12-inch-long piece of each type specified, including color.

2. Corridor Handrail: 12-inch-long piece of each specified type, including mounting bracket and specified finish.

3. Partition End and Corner Guards: 12-inch-long piece of each type specified, including color.

4. Wall protection and Door Protection: 12-inch-square piece of each specified type, including corner and specified color.

1.3 PRODUCT HANDLING

A. Delivery and Storage: Deliver and store items and related fasteners in manufacturer's original packaging, identified with manufacturer's name and type of product, and size. Store materials indoors, protected from moisture and other sources of damage.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. General: Provide vinyl/acrovyn wall and corner protection single-sourced from one manufacturer to assure color matching.

B. Manufacturer: Inpro Corporation, Construction Specialties, Inc., OR Pawling Corporation

a. Basis-of-Design: Construction Specialties, Inc.,

C. Fire Hazard Classification: Flame spread of 25 or less when tested per ASTM E84.

2.2 CORNER GUARDS

A. Type: C/S Acrovyn 4000 Corner Guards – SM-20MN with continuous aluminum retainer.

1. Size: 3-inch by 3-inch by 4 feet high. Provide angled corner guards at all angled corners.

2. Mounting Style: Surface-mounted with aluminum retainer.

3. Color: As selected by Architect from manufacturer's full range.

4. Mounting Height: From top of base.

5. Locations: All Outside Wall Corner Locations.

~~B. Type: Construction Specialties CO-8 Stainless Steel Corner Guard.~~

~~1. Size: 3 1/2-inch by 3 1/2-inch by Full Height.~~

~~2. Mounting Style: Surface-mounted.~~

~~3. Finish: Type 304, Stainless Steel.~~

~~4. Mounting Height: From top of base.~~

~~5. Locations: All Outside Wall Corner Locations in Operating Rooms.~~

2.3 PROTECTIVE WALL COVERING WAINSCOT

A. Type: Sheet plastic wall protection by C/S acrovyn. Typical where shown on Drawings.

1. Size: 0.06" thick Acrovyn 4000 panels by sizes shown on Drawings.

2. Mounting Style: Surface-mounted.

3. Color: As scheduled on Drawings.

4. Mounting Height: From finished floor to 4 feet above base unless noted otherwise. Align top of wall protection with top of corner guards where occurs.

1. Locations: As shown on Drawings.

2.4 HANDRAILS

A. Manufacturer: Acrovyn by Construction Specialties, Inc. (C/S); IPC Door and Wall Protection by InPro Corporation (IPC). C/S Acrovyn specified as basis-of-design.

B. Type: Construction Specialties Acrovyn HRWS-6C, surface-mounted crash rail. Typical at corridors.

1. Overall Projection from Wall: 3 inches.

2. Overall Height: 4-3/32 inches.

3. Wood Finish: Natural Maple.

4. Mounting Height: As shown on Drawings.

5. Locations: Typical at all patient room side of the wall and as shown on Drawings.

6. Include manufacturer's stainless steel (Model 245069000) Splice at mide-point of all runs that exceed maximum dowel length.

2.5 CRASH RAILS

A. Manufacturer: Acrovyn by Construction Specialties, Inc. (C/S); IPC Door and Wall Protection by InPro Corporation (IPC). C/S Acrovyn specified as basis-of-design.

B. Type: Construction Specialties Acrovyn SCR-64 MN, surface-mounted crash rail with continuous aluminum retainer. Typical at corridors, as shown on Drawings.

1. Size: 1-1/4-inch-wide by 8 inches X continuous.

2. Mounting Style: BCR-64, maximum projection from wall 1-1/2-inch.

3. Color: As scheduled on Drawings.

4. Mounting Height: As shown on Drawings.

6. Locations: Typical at all 8 feet corridors.

2.6 PARTITION END PROTECTION

A Manufacturer: Acrovyn by Construction Specialties, Inc. (C/S); IPC Door and Wall Protection by InPro Corporation (IPC).C/S Acrovyn specified as basis-of-design.

B. Type: Composite assembly consisting of two Acrovyn SSM-20AN corner guards and partition-end infill panel of adhesive-applied .040-inch-thick Acrovyn sheet.

1. Size: Verify partition width; 2-inch return at each wall face.

2. Mounting Style: Surface-mounted.

3. Color: As scheduled on Drawings.

4. Mounting Height: From finish floor to 4 feet above base.

5. Provide manufacturer's coordinated top and bottom caps.

1. Locations: **At all wall end partitions, typical.**

2.7 MISCELLANEOUS MATERIALS

A. Fasteners: Manufacturer's standard, removable, corrosion-resistant fasteners of size and length suitable for the conditions of installation.

B. Adhesive: As recommended by manufacturer for setting material.

C. Backing Plates: As specified in Section 092216 – Non-Structural Metal Framing and as shown on Drawings.

D. Products shall be furnished as a complete packaged system, including appropriate Adhesive, Primer, Caulking and Trims per manufactures recommendations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: After application of wall base and finish painting of walls is complete, examine areas and conditions under which items are to be installed. If unsatisfactory conditions exist, do not proceed with the Work until such conditions have been corrected.

3.2 PREPARATION

A. Cleaning: Prior to application, clean side of units that will be in contact with wall surface.

3.3 INSTALLATION

A. Install the work of this section in strict accordance with the manufacturer's recommendations, using only approved mounting hardware and locating all components firmly into position, level and plumb.
B. Temperature at the time of installation must be between 65°-75°F (18°-24°C) and be maintained for at least 48 hours after the installation.
C. Adjust installed end caps as necessary to ensure tight seams.

3.4 ADJUSTING AND CLEANING

A. Cleaning: Prior to time of final acceptance, strip units of protective coverings, and clean in accordance with manufacturer's instructions.

B. Defective Materials: Remove and replace any defective, misaligned, or damaged units, at no additional cost to Owner.

END OF SECTION

SECTION 102800– TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Work included: Provide and install toilet accessories as shown on Drawings and as specified, including:

1. Single-accommodation toilet room accessories.

B. Work Specified Elsewhere:

1. Section 088000 –Glazing.

2. Section 092216 – Non-Structural Metal Framing.

3. Division 23 – Mechanical (Pipe Protection under Lavatories).

1.2 SUBMITTALS

A. Comply with provisions of Section 013300 – Submittal Procedures

B. Manufacturer's literature describing products.

C. Shop Drawings: Show methods of backing, installation, and fastening.

1.3 QUALITY ASSURANCE

A. Installed grab bars shall withstand 300 pounds downward pull.

B. Design, quality, capacity, function, and finish shall conform with manufacturer's descriptions corresponding to catalog numbers cited unless otherwise noted.

C. Provide the same keying for all locks of all accessory units specified.

1.4 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements of Section 016000 – Product Requirements.

B. Deliver materials and products in original containers with seals unbroken and labels intact until time of use. Label shall identify accessory, catalog number and finish.

C. Store delivered products in clean, safe, dry area.

1.5 PROJECT CONDITIONS

A. Comply with requirements of Section 013100 – Project Management and

Coordination.

B. Coordinate as required with work of other sections to ensure proper backing.

C. Sequencing, Scheduling: Do not install accessories until after completion of finish painting.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. General: Bobrick Washroom Equipment, Inc., no substitutions permitted unless otherwise specified. Accessory items specified by Bobrick catalog numbers.

2.2 PRODUCTS:

A. Grab Bars:

Provide heavy duty 18-guage, type 304 stainless steel grab bars complying with the following:

1. Products: Bobrick; B-5806, 18", 24", 36" & 42" grab bars as indicated on drawings.
2. Mounting: Concealed with manufacturer's standard flanges and anchors.
3. Gripping Surfaces: Smooth, satin finish.
4. Outside Diameter: 1-1/4 inches for heavy-duty applications.

B. Mirror Unit:

Provide mirror unit complying with the following:

1. Products: Bobrick; B-165, 24" x 36" - Channel Frame Mirror
2. Stainless-Steel, Channel-Framed Mirror: Fabricate frame from stainless-steel channels in manufacturer's standard satin or bright finish with square corners mitered to hairline joints and mechanically interlocked.

C. Robe Hooks:

1. Model B-6717; single robe hook; surface-mounted; Type 304, stainless steel with satin finish.

D. Toilet Seat Cover Dispenser:

1. Model B-221 Surface-Mounted Toilet Seat Cover Dispenser; dispenses 250 single or half-fold seat covers; Type 304 stainless steel satin finish; fill from bottom through concealed opening.

E. Sanitary Napkin Disposal:

1. Model B-270; Contura series, surface mounted sanitary napkin dispenser with full-length piano hinge and hinged bottom with tumbler lock; type 304 stainless steel with satin finish.

~~F. Pass-Thru Cabinet:~~
~~1. OFCI~~

G. Mop and Broom Holder:

1. Model B-223x36; anti-slip mop holders with spring-loaded rubber cam on steel retainers; surface-mounted; Type 304 satin finish stainless steel; 36 inches long.

H. Stainless Steel Shelf:
1. Model B-295 x16; 16" long X 5" wide, 18-gauge, type 304 stainless steel, satin finish, ¾" return edge; front edge hemmed for safety. Brackets 16- gauge

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine area to receive toilet or bath accessories and certify that:

1. Backing not included in work of this section is correct.

2. Surfaces are dry, clean, free from foreign matter, and otherwise proper for installation.

3. Toilet compartments or dressing rooms, to receive accessories have been properly installed and correctly prepared.

B. Do not begin work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install accessories in accordance with approved manufacturer's recommendations.

B. Attach accessories securely to substantial backing, with concealed fastenings unless otherwise noted; insure true alignment.

C. Adjust as required for correct operation.

3.3 CLEANING AND ADJUSTMENTS

A. Comply with requirements of Section 017900 – Cleaning.

B. Adjust units as necessary to assure smooth, quiet operation without catching, binding or malfunctioning.

END OF SECTION

SECTION 104413 – FIRE PROTECTION CABINETS AND FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included: Provide and install fire extinguishers and cabinets and accessories as shown on Drawings and as specified, including:

1. Fire extinguishers.

2. Fire extinguisher cabinets and accessories.

B. Work Specified Elsewhere:

1. Section 092216 – Non-Structural Metal Framing.

2. Section 092900 – Gypsum Board.

3. Section 099123 – Interior Painting.

1.2 SUBMITTALS

A. Comply with provisions of Section 013300 – Submittal Procedures.

B. Submit manufacturer's literature describing products.

C. Shop Drawings: Submit showing locations, sizes, methods of attachment, and rough-in dimensions.

D. Certification: Installer shall submit written certification that the fire extinguishers installed comply with the contract documents and are fully and correctly charged.

1.3 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain extinguishers and cabinets from one source from a single manufacturer.

B. Provide only fire extinguishers which comply with NFPA 10.

C. UL Listed Products: Fire extinguishers shall be UL Listed with UL Listing mark for type, rating, and classification of extinguisher.

D. Conform to NFPA 10, International Building Code (IBC) with 2003 Utah Amendments, and local Fire Marshall requirements, including:

1. Location: Provide portable fire extinguishers within 75 feet maximum travel distance to any occupied interior portion of the building.

2. Provide additional high hazard portable fire extinguishers in hazardous

locations as local governing codes.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Comply with provisions of Section 016000 – Product Requirements.

B. Deliver and store packaged products in original containers with seals unbroken and labels intact until time of use.

C. Provide proper facilities for handling and storage of products to prevent damage. Where necessary, stack products off ground on level platform, fully protected from weather.

1.5 PROJECT CONDITIONS

A. Sequencing: Schedule installation of items to occur after application of exposed finishes wherever installation will not damage exposed finish surfaces and completion of finishes will not impede installation.

B. Do not deliver or install extinguishers until just before substantial completion.

C. Do not use permanent fire extinguishers for construction period fire protection.

PART 2 – PRODUCTS

2.1 FIRE EXTINGUISHERS

A. Manufacturer: Provide products manufactured by Potter Roemer; Div. of Smith Industries, Inc; Amerex Corporation; JL Industries, Inc; Larsen's Manufacturing Company; Badger, or Nystrom.

1. Basis-of-Design: Products manufactured by Activar Inc, JL Industries are the Basis-of-Design for sizes as shown on Drawings.

B. Fire Extinguisher Types:

1. Typical:

a. Capacity: 10 LBS

b. UL Rating: 2A-10BC

b. Type: ABC multi-purpose dry chemical; stored pressure type.

c. Model: JL Industries, Cosmic 10E

d. Cabinet mounted (typical).

~~C. Fire Extinguisher Types at Operating Rooms:~~

~~1. Carbon Dioxide Type:~~

~~a. UL Rating: 10BC; 10-pound capacity, or greater.~~

~~b. Type: Class B and C. Extinguisher unit containing liquid carbon dioxide under pressure.~~

~~c. Model: JL Industries, Sentinel 10~~

~~d. Cabinet mounted (typical).~~

2.2 CABINETS AND CABINET ACCESSORIES

A. Cabinet Type (All Locations except for Operating Rooms):

Fully Recessed style with duo vertical panel with pull handle.

1. Construction of cold rolled steel formed, mitered, welded and ground smooth; 20 gauge tubular door and 18 gauge frame; rolled radius edge treatment.

2. Cabinet door and trim shall be finished with white power coat finish.

3. Interior shall be finished in white baked enamel.

4. Provide JL Industries, 1035 V/W Vertical Duo with 3/8" flat trim fully recessed.

C. Hinges: Provide hinges for each door; concealed or continuous type; allow full 180 degree opening of door.

1. Exposed hinges: Finish to match door.

~~D. Cabinet Type at Operating Rooms~~

~~Fully Recessed style with duo vertical panel with pull handle.~~

~~1. #4 Stainless Steel cabinet with clear tempered glazing~~

~~2. Door Style: Vertical Duo with 3/8" flat trim fully recessed.~~

E. General

1. Provide 'FIRE EXTINGUISHER' decal for each cabinet. Orient letters vertically.
2. Provide standard fixed door pull at each cabinet.
3. Keys to Door Locks: Three per lock

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine construction to support, adjoin, or otherwise contact and verify that:

1. Dimensions are correct.

2. Load-bearing studs or backing are available where required by weight of items.

3. Setting conditions are dry, clean, and otherwise proper for installation.

B. Do not install items until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate details with other work supporting, adjoining, or otherwise contacting items as required to insure proper installation.

3.3 INSTALLATION

A. Install extinguishers and cabinets within limitations of NFPA-10 and ADA. Maximum travel distance to Class A extinguisher: 75 FT. Maximum area 11,250 SF

B. Perform installation in accordance with the manufacturer's printed instructions except where more stringent requirements are shown or specified.

1. Comply with Contract Documents where project conditions require extra precautions or provisions to ensure satisfactory performance of the work.

C. Install extinguishers and cabinets at locations indicated in accordance with approved shop drawings.

1. Typical Fastenings: Use machine screws or bolts to metal backing. Toggle bolts will not be permitted.

2. Drill and tap mounting surfaces for mounting hardware as required.

D. Locate with centerline of cabinet door handle not more than 48 IN AFF.

E. Wall Signs:

1. Location: Provide 2-Wat Slim Line extinguisher sign aove fire extinguisher cabinet. Basis of Design: MCMaster-Carr 5758T46 or approved equal.
2. Apply on walls after field painting is completed and has been accepted.

3.4 FIELD QUALITY CONTROL

A. Ensure that each extinguisher is fully charged, and that inspection of each extinguisher has been performed, as evidenced by the National Association of Fire Equipment Distributors certification tag, just prior to turnover.

END OF SECTION

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SECTION 211000 - WATER-BASED FIRE-SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-suppression piping, fittings, and appurtenances.
2. Fire-suppression piping specialties.
3. Sprinklers.
4. Pressure gauges.

1.2 DEFINITIONS

A. Standard-Pressure Fire-Suppression System Piping: Piping designed to operate at working pressure of 175 psig maximum.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

a. Include construction details, material descriptions, dimensions of individual components and profiles.
b. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Prepare in accordance with NFPA 13 section "Working Plans."

a. Include plans, elevations, and sections of the system piping and details.
b. Include detailed riser diagram and schematic diagram showing system supply, supply connection, devices, valves, pipe and fittings, as well as the delineation of the standard-pressure and high-pressure portions of the fire-suppression system.
c. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Prepare computer-generated hydraulic calculations in accordance with the following:
a. Name of hydraulic program used.
b. Water supply information, including fire hydrant flow test data report.

3. Submit documents and calculations prepared by NICET Level III-certified technician, "Water-Based Systems Layout." NICET certified-technician submittals

are to include the following information on each drawing title block: technician's name, NICET certification number, and NICET certification specialty area and level.

4. Include diagrams for power, signal, and control wiring.

C. Delegated Design Submittals: For fire-suppression systems indicated to comply with performance requirements and design criteria, including analysis data, prepared by NICET Level III-certified technician, "Water-Based Systems Layout." NICET certified-technician submittals are to include the following information on each drawing title block: technician's name, NICET certification number, and NICET certification specialty area and level.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Fire-suppression system plans and sections, or Building Information Model (BIM), drawn to scale, showing the items described in this Section and coordinated with all building trades.

B. Seismic Qualification Certificates: For fire-suppression equipment, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Qualification Data: For qualified Installer NICET-certified technician.

D. Design Data: Approved fire-suppression piping working plans, prepared in accordance with NFPA 13, including documented approval by AHJs, and including hydraulic calculations if applicable.

E. Welding certificates.

F. Field Test Reports:

1. 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."
2. Fire-hydrant flow test report.

G. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-suppression systems and specialties to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.
2. System control valves.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a minimum NICET Level III-certified technician, "Water-Based Systems Layout."

B. Welding Qualifications: Qualify procedures and operators in accordance with ASME Boiler and Pressure Vessel Code.

1.8 FIELD CONDITIONS

A. Interruption of Existing Fire-Suppression Service: Do not interrupt fire-suppression service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary fire-suppression service in accordance with requirements indicated:

1. Notify Construction Manager and Owner no fewer than seven days in advance of proposed interruption of fire-suppression service.
2. Do not proceed with interruption of fire-suppression service without Construction Manager's and Owner's written permission.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Automatic wet-pipe sprinkler system.
1. Modify the existing wet-pipe system to meet remodel conditions.
2. Remove and replace existing drops to below ceilings with new equipment. Use only schedule 40 black steel pipe and white, concealed standard spray quick response sprinklers below ceilings.
3. Upright sprinklers may be bronze.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire-suppression system piping to withstand the effects of earthquake motions determined in accordance with NFPA 13 and ASCE/SEI 7. See Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."

B. Fire-Suppression System Components, Devices, and Accessories: Listed in UL's "Fire Protection Equipment Directory" and FM Approvals' "Approval Guide."

C. 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.

D. Standard-Pressure Piping System Component: Listed for 175 psig minimum working pressure.

E. Delegated Design: Engage a NICET Level III-certified technician, "Water-Based Systems Layout" to design fire-suppression systems.

1. Fire-Hydrant Flow Test:

a. Perform fire-hydrant flow test and record the following conditions:

1) Date: .
2) Time: a.m. p.m.
3) Performed by: of.
4) Location of Residual Fire Hydrant R: .
5) Location of Flow Fire Hydrant F: .
6) Static Pressure at Residual Fire Hydrant R: .
7) Measured Flow at Flow Fire Hydrant F: .
8) Residual Pressure at Residual Fire Hydrant R: .

b. Fire-hydrant flow test must be performed within previous 12 months prior to completion of design documents and hydraulic calculations unless AHJ requires a smaller time period.

2. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
3. Sprinkler Occupancy Hazard Classifications:
   a. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
   b. Elevator Machine Room and Hoist way: Ordinary Hazard, Group 1.
   c. General Storage Areas: Ordinary Hazard, Group 1.
   d. Institutional: Light Hazard.
   e. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
   f. Offices, including Data Processing: Light Hazard.

4. Minimum Density for Automatic-Sprinkler Piping Design:
   a. Light-Hazard Occupancy: 0.10 gpm/sq. ft. over 1500 sq. ft. area.
   b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm/sq. ft. over 1500 sq. ft. area.
   c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm/sq. ft. over 1500 sq. ft. area.

d. Special Occupancy Hazard: As determined by AHJs.

5. Maximum Protection Area per Sprinkler:
   a. Office Spaces: 225 sq. ft.
   b. Storage Areas: 130 sq. ft.
   c. Mechanical Equipment Rooms: 130 sq. ft.
   d. Electrical Equipment Rooms: 130 sq. ft.
   e. Other Areas: In accordance with NFPA 13 recommendations unless otherwise indicated.

6. Total Combined Hose-Stream Demand Requirement: In accordance with NFPA 13 unless otherwise indicated:

   a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
   b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.
   c. Extra-Hazard Occupancies: 500 gpm for 90 to 120 minutes.

F. Obtain documented approval of fire-suppression system design from AHJs.

2.3 FIRE-SUPPRESSION PIPING, FITTINGS, AND APPURTENANCES

A. Steel Pipe, Fittings, and Appurtenances:

1. Schedule 40 Steel Pipe: black-steel pipe, ASTM A53/A53M, ASTM A135/A135M, or ASTM A795/A795M.

   a. Standards:

      1) UL 852.
      2) FM 1630.

   b. Factory-applied exterior coating.
   c. Factory-applied bacterial-resistant internal coating to reduce microbiologically influenced corrosion.
   d. Pipe ends may be factory or field formed to match joining method.

2. Schedule 10 Steel Pipe: black-steel pipe, ASTM A53/A53M, ASTM A135/A135M, or ASTM A795/A795M.

   a. Standards:

      1) UL 852.
      2) FM 1630.

   b. Factory-applied exterior coating.
   c. Factory-applied bacterial resistant internal coating to reduce microbiologically influenced corrosion.
   d. Pipe ends may be factory or field formed to match joining method.

3. Engineered Light-Wall Steel Pipe: black-steel pipe, ASTM A135/A135M or ASTM A795/A795M with wall thickness less than Schedule 40. Outside dimension is to be equivalent to Schedule 40.

a. Standards:

1) UL 852.
2) FM 1630.

b. Factory-applied exterior coating.
c. Factory-applied bacterial-resistant internal coating to reduce microbiologically influenced corrosion.
d. Pipe ends may be factory or field formed to match joining method.

4. Steel Pipe Nipples: black steel, ASTM A733, made of ASTM A53/A53M, standard-weight, seamless steel pipe with threaded ends.
5. Steel Couplings: Galvanized and uncoated steel, ASTM A865/A865M, threaded.
6. Gray-Iron Threaded Fittings: Galvanized and uncoated gray-iron threaded fittings, ASME B16.4, Class 125, standard pattern.
7. Malleable- or Ductile-Iron Unions: ASME B16.3.
8. Cast-Iron Flanges: ASME B16.1, Class 125.
9. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

a. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick ASME B16.21, nonmetallic and asbestos free or EPDM rubber gasket.

1) Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
2) Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.

b. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1 carbon steel unless otherwise indicated.

10. Steel Welding Fittings: ASTM A234/A234M and ASME B16.9.

a. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

11. Grooved-Joint, Steel-Pipe Appurtenances:
a. Pressure Rating: 175 psig minimum.
b. Grooved-End Fittings for Steel Piping: Galvanized Painted Uncoated grooved-end fittings, ASTM A47/A47M, malleable-iron casting or ASTM A536, ductile-iron casting, with dimensions matching steel pipe.
c. 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.

2.4 SYSTEM CONTROL VALVES

A. Listed in UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."

B. Pressure Rating:

1. Standard-Pressure Piping Valves: 175 psig minimum.

C. Body Material: Cast or ductile iron.

D. Size: Same as connected piping.

E. End Connections: Flanged or grooved.

2.5 FIRE-SUPPRESSION PIPING SPECIALTIES

A. Branch Outlet Fittings:
1. Standard: UL 213.
2. Pressure Rating: 175 psig minimum.
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. Flexible Sprinkler Hose Fittings:
1. Standards:
   a. UL 2443.
   b. FM 1637.
2. Description: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
3. Pressure Rating: 175 psig minimum.
4. Size: Same as connected piping, for sprinkler.

C. Automatic Air Vent:
1. Description: Automatic air vent that automatically vents trapped air without human intervention. Approved for use in wet-pipe fire-suppression system.
2. Vents oxygen continuously from system.
3. Float valve to prevent water discharge.
4. Minimum Water Working Pressure Rating: 175 psig.

2.6 SPRINKLERS

A. Standards:

1. UL 199.
2. UL 1767.
3. UL 1626.
4. FM 2000.
5. FM 2008.
6. FM 2030.

B. Listed in UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."

C. Pressure Rating for Sprinklers:

1. Standard Automatic Sprinklers: 175 psig minimum.

D. Sprinklers, Automatic Wet with Heat-Responsive Element:

1. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
2. Standard Spray, Standard Response:

a. Upright.
b. Pendent.
c. Recessed pendent.
d. Flat, concealed pendent.
e. Vertical sidewall.
f. Horizontal sidewall.

3. Standard Spray, Quick Response:

a. Upright.
b. Pendent.
c. Recessed pendent.
d. Flat, concealed pendent.
e. Vertical sidewall.
f. Horizontal sidewall.
g. Flat, concealed horizontal sidewall.

E. Sprinkler Finishes: Chrome plated bronze and painted.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Plastic, white finish, one piece, flat.
2. Sidewall Mounting: Plastic, white finish, one piece, flat.

G. Sprinkler Guards and Water Shields:
1. Standard: UL 199.
2. Description: Wire cage with fastening device for attaching to sprinkler.

2.7 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. Water System Piping Gauge: Include "WATER" or "AIR/WATER" label on dial face.

E. Air System Piping Gauge: Include "AIR" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test. Use results for system design calculations required in "Quality Assurance" Article.

1. Flow test is to be performed to meet the criteria established by NFPA 13.
2. Flow test is to be conducted in accordance with NFPA 291.
3. Test is to be performed during a period of ordinary demand for the water system.

    a. To obtain satisfactory test results of expected flow or rated capacities, sufficient discharge should be achieved to cause drop of at least 10 percent.

4. Pitot readings are to be taken at the 2-1/2-inch orifice connection.
5. The pitot reading is to range from 10 to 35 psig.
6. Open additional hydrant outlets as needed to control pitot readings.
7. The pitot pressure and corresponding residual pressure readings are to be taken consecutively as pressure fluctuates between a high number and low number.

B. Flow Test Data Written Report:

1. Flow data report is to be written in accordance with NFPA 291.
2. Flow data report is to include a copy of all flow data recorded during the test, including a site plan showing the tested fire hydrants with respect to the fire water service to the building. Site plan is to indicate which hydrant was flowed and which hydrant was used for pressure reading. Provide date of test, name of testing agency, and name of individual performing test.

C. Water Supply Curve: Provide water supply curve based on the lowest supply for a given set of test data. For a given residual pressure reading, the supply is to be graphed utilizing the corresponding pitot pressure/flow reading and static pressure reading.

D. Documentation is to include calibration certifications for gauges used in the flow tests. The certifications are to be from within the previous six (6) months from a reputable agency recognized for certifying pressure gauges.

E. Report flow test results promptly and in writing. A copy of the flow test data report is to be submitted with the hydraulic calculations.

3.2 INSTALLATION OF FIRE-SUPPRESSION PIPING

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 AHJs. File written approval with Architect 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 fire-suppression piping.

C. Install seismic restraints on piping. Comply with NFPA standards requirements for seismic-restraint device materials and installation.

D. Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 and smaller.

F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

G. Install inspector's test connections in sprinkler system piping, complete with shutoff valve, and sized and located in accordance with NFPA 13.

H. Install fire-suppression system piping with drains for complete system drainage. Extend drain piping to exterior of building where possible.

I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Install automatic (ball drip) drain valve at each check valve for fire department connection, to drain piping between fire department connection and check valve. Install drain piping to and spill over floor drain or to exterior of building.

K. Install alarm devices in piping systems.

L. Install hangers and supports for fire-suppression piping in accordance with NFPA standards.

M. Install pressure gauges on riser or feed main, at each sprinkler test connection, and at top of each standpipe/sprinkler supply. 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.

N. Fill wet-type fire-suppression system piping with water.

O. Install sleeves for piping penetrations of walls, ceilings, and floors.

P. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.3 INSTALLATION OF PIPING JOINTS

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 NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger 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 in accordance with ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads in accordance with 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. Welded Joints: Construct joints in accordance with AWS D10.12M/D10.12, using qualified processes and welding operators in accordance with "Quality Assurance" Article.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe in accordance with AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings in accordance with AWWA C606 for steel-pipe joints.

J. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe in accordance with AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings in accordance with AWWA C606 for steel-pipe grooved joints.

K. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 INSTALLATION OF VALVES AND SPECIALTIES

A. Install listed fire-suppression system control valves, trim and drain valves, specialty valves and trim, controls, and specialties in accordance with manufacturer's installation instructions, NFPA standards, and AHJ.

B. Install listed fire-suppression system shutoff valves in supervised open position, 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. Air Vent:

1. Provide at least one air vent at high point in each wet-pipe fire-suppression system in accordance with NFPA standards. Connect vent into top of fire-suppression piping.
2. Provide dielectric union for dissimilar metals, ball valve, and strainer upstream of automatic air vent.
3. Pipe from outlet of air vent to drain.

3.5 INSTALLATION OF SPRINKLERS

A. Install sprinklers in suspended ceilings symmetrically in center of narrow dimension of acoustical ceiling panels within tolerance of 1/2 inch. Coordinate entire pattern of sprinkler locations with approved reflected ceiling plan.

B. 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 in accordance with requirements for identification specified in Section 210553 "Identification for Fire-Suppression Piping and Equipment."

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Perform the following tests and inspections:

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 fire-suppression systems in accordance with NFPA standards.
4. Energize circuits to electrical equipment and devices.
5. Start and run air compressors.
6. Coordinate with fire-alarm tests. Operate as required.
7. Coordinate with fire-pump tests. Operate as required.
8. Verify that equipment hose threads are same as local fire department equipment.

9. Verify that sprinklers original factory finish has not been contaminated with dirt, debris, or paint. Sprinklers containing other-than-original factory finish are to be considered defective and replaced with new products. Repair and/or cleaning is not acceptable.

C. Fire-suppression piping system will be considered defective if it does not pass tests and inspections.

D. Fire-suppression piping system components considered defective during testing will be replaced with new components. Repair of defective components is not acceptable.

E. Prepare test and inspection reports.

3.8 CLEANING

A. Clean dirt and debris from fire-suppression system piping, system control valves, sprinklers, and associated components.

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.

3.9 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain the system.

3.10 PIPING SCHEDULE

A. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

B. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 4 (DN 100) and Smaller, to Be One of the Following:

1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Schedule 40, black-steel pipe with cut- or roll- grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
3. Schedule 40, black-steel pipe with plain ends; steel welding fittings; and welded joints.

C. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 5 (DN 125) and Larger, to Be One of the Following:

1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Schedule 40, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3. Schedule 40, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
4. Schedule 40, black-steel pipe with plain ends; steel welding fittings; and welded joints.
5. Schedule 10 or engineered light-wall, steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
6. Schedule 10 or engineered light-wall, steel pipe with plain ends; welding fittings; and welded joints.

3.11 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Pendent, recessed sprinklers.
3. Wall Mounting: Horizontal sidewall sprinklers.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces and locations not generally exposed to view; and wax coated where exposed to acids, chemicals, or other corrosive fumes.
2. Recessed Sprinklers: White, with factory-painted white escutcheon.
3. Flat Concealed Sprinklers: Rough brass, with factory-painted white cover plate.

END OF SECTION 211000

SECTION 220529

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 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.

1.2 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 and obtain approval from authorities having jurisdiction.

1.3 ACTION SUBMITTALS

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

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.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 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

2.1 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: Pregalvanized 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. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. 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 copper-coated steel.

2.2 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.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.

B. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-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.

2.4 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.

2.5 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.

2.6 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 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, non-shrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Non-staining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 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.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 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.

3.4 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.

3.5 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. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 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 stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. 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.

K. 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.

L. 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.

M. 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.

N. 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.

O. 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.

P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

R. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220553

IDENTIFICATION FOR PLUMBING 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 indicated.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: White.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. 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.
6. Fasteners: Stainless-steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: White.
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.

C. 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.

D. 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, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: White.

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-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.

J. Pipe Label Color Schedule:

1. Low-Pressure Compressed Air Piping:

a. Background: Safety blue.
b. Letter Colors: White.

2. High-Pressure Compressed Air Piping:

    a. Background: Safety blue.
    b. Letter Colors: White.

3. Domestic Water Piping

    a. Background: Safety green.
    b. Letter Colors: White.

4. Sanitary Waste and Storm Drainage Piping:

    a. Background Color: Safety black.
    b. Letter Color: White.

END OF SECTION 220553

SECTION 220719

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic hot-water piping.
2. Sanitary waste piping exposed to freezing conditions.
3. Supplies and drains for handicap-accessible lavatories and sinks.

B. Related Sections:

1. Section 220716 "Plumbing Equipment Insulation."

1.2 ACTION SUBMITTALS

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

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content and chemical components.
2. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that product complies 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."

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 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.

B. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping 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. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Special-Shaped Insulation: ASTM C 552, Type III.
2. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.

3. Preformed Pipe Insulation with Factory-Applied: Comply with ASTM C 552, Type II, Class 2.
4. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

H. Mineral-Fiber, Preformed Pipe Insulation:

1. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, without factory-applied jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

I. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials.

2.2 INSULATING CEMENTS

A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

2.3 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. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

F. PVC Jacket Adhesive: Compatible with PVC jacket.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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.

2.5 SEALANTS

A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
4. Color: White or gray.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants 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."

B. 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.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants 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."

C. ASJ Flashing Sealants, and Vinyl, PVDC, 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.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants 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."

2.6 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.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.

2.8 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. Adhesive: As recommended by jacket material manufacturer.
2. Color: White Color-code jackets based on university system. 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.

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.

2.9 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. 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.

D. 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.

2.10 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. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy.

2.11 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:
1. 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. 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

3.1 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.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe 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. 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 and at ends adjacent to pipe flanges and fittings.

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. Cleanouts.

3.3 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 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 078413 "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 078413 "Penetration Firestopping."

3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe

insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. 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.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches

over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.6 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.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 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 Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube 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 polyolefin 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 polyolefin 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.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.9 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. 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.

C. 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.

3.10 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "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. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.11 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, 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 three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

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

3.12 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.13 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Hot and Recirculated Hot Water piping up to 1-1/4": Insulation shall be one of the following:
1. Flexible Elastomeric: 1-1/2 inch thick.
2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
3. Polyolefin: 1-1/2 inch thick.

B. Domestic Cold Water piping up to 1-1/4": Insulation shall be one of the following:
1. Flexible Elastomeric: 3/4 inch thick.
2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
3. Polyolefin: 3/4 inch thick.

C. Piping Exposed to Ambient Conditions: Insulation shall be one of the following:

1. Flexible Elastomeric: 3 inch thick.
2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inch thick.
Polyolefin: 3 inch thick.

3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

D. Piping, Exposed:

1. PVC, Color-Coded by System: 20 mils thick.

3.15 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

3.16 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified by architect.

B. 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.

END OF SECTION 220719

SECTION 221116

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Aboveground domestic water pipes, tubes, and fittings inside buildings.

1.3 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

1.4 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

1.5 FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of water service.
2. Do not interrupt water service without Owner's written permission.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Ordering: Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.

B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.
   1. Store PEX tubing in cartons or under cover to avoid dirt or foreign material from entering the tubing.
   2. Do not expose PEX tubing to direct sunlight for more than 30 days. If construction delays are encountered, cover the tubing to prevent exposure to direct sunlight

PART 2 - PRODUCTS

2.1 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.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

B. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

C. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

D. 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.

E. Copper Pressure-Seal-Joint Fittings:
   1. Fittings for NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
   2. Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

F. Copper Push-on-Joint Fittings:
   1. Description:

      a. Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22.
      b. Stainless-steel teeth and EPDM-rubber, O-ring seal in each end instead of solder-joint ends.

2.3 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. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.'

2.4 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.

C. Sleeve-Type Transition Coupling: AWWA C219.

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

a. Cascade Waterworks Manufacturing.
b. Dresser, Inc.; Piping Specialties Products.
c. Ford Meter Box Company, Inc. (The).
d. JCM Industries.
e. Romac Industries, Inc.
f. Smith-Blair, Inc.; a Sensus company.
g. Viking Johnson.

2.5 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. 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. Hart Industries International, Inc.
d. Jomar International.
e. Matco-Norca.
f. McDonald, A. Y. Mfg. Co.
g. Watts; a division of Watts Water Technologies, Inc.
h. Wilkins; a Zurn company.

2. Standard: ASSE 1079.
3. Pressure Rating: 250 psig at 180 deg F.
4. End Connections: Solder-joint copper alloy and threaded ferrous.

C. 175 psig minimum150 psigDielectric Nipples:

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

a. Elster Perfection Corporation.
b. Grinnell Mechanical Products; Tyco Fire Products LP.
c. Matco-Norca.
d. Precision Plumbing Products, Inc.
e. Victaulic Company.

2. Standard: IAPMO PS 66.
3. Electroplated steel nipple complying with ASTM F 1545.
4. Pressure Rating and Temperature: 300 psig at 225 deg F.
5. End Connections: Male threaded or grooved.
6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 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 shutoff valve immediately upstream of each dielectric fitting.

C. Install domestic water piping level without pitch and plumb.

D. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

E. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

F. 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.

G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

H. Install piping to permit valve servicing.

I. 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.

J. Install piping free of sags and bends.

K. Install fittings for changes in direction and branch connections.

L. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

M. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 230519 "Meters and Gages for Hydronic Piping."

N. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."

O. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 230519 "Meters and Gages for Hydronic Piping."

3.2 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. 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."

E. 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.

F. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.3 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. NPS 1-1/2NPS 2Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.4 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.

3.5 NPS 2-1/2 to NPS 4HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. "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.

3. 100 Feet100 Feet100 FeetBase 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.

F. NPS 2-1/2108 inches1/2-inchNPS 3 to NPS 510 feet1/2-inchInstall supports for vertical copper tubing every 10 feet.

G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.6 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. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
   2. 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.

3.7 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 230553 "Identification for Mechanical Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.8 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.

3.9 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. Clean non-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 procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. 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. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and soldered joints.

3.12 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
2. NPS 2NPS 2-1/2Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
3. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 221116

SECTION 221119

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated, water mixing valves.
6. Strainers.
7. Outlet boxes.
8. Drain valves.
9. Water-hammer arresters.
10. Air vents.
11. Trap-seal primer valves.
12. Trap-seal primer systems.
13. Specialty valves.
14. Flexible connectors.
15. Water meters.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61.

2.2 PERFORMANCE REQUIREMENTS

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

2.3 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.

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.

C. Pressure Vacuum Breakers :

1. Standard: ASSE 1020.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 5 psig maximum, through middle third of flow range.
4. Accessories:

a. Valves: Ball type, on inlet and outlet.

D. Laboratory-Faucet Vacuum Breakers:

1. Standard: ASSE 1035.
2. Size: NPS 1/4 or NPS 3/8 matching faucet size.
3. Body: Bronze.
4. End Connections: Threaded.
5. Finish: Chrome plated.

E. Spill-Resistant Vacuum Breakers :

1. Standard: ASSE 1056.
2. Operation: Continuous-pressure applications.
3. Accessories:

a. Valves: Ball type, on inlet and outlet.

2.4 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers:

1. Standard: ASSE 1012.
2. Operation: Continuous-pressure applications.
3. Body: Bronze.

B. Reduced-Pressure-Principle Backflow Preventers:

1. Standard: ASSE 1013.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 12 psig maximum, through middle third of flow range.
4. Body: Bronze for NPS 2 and smaller; stainless steel for NPS 2-1/2 and larger.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
6. Configuration: Designed for horizontal, straight-through flow.
7. Accessories:

    a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
    b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
    c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

C. Double-Check, Backflow-Prevention Assemblies:

1. Standard: ASSE 1015.
2. Operation: Continuous-pressure applications unless otherwise indicated.
3. Pressure Loss: 5 psig maximum, through middle third of flow range.
4. Body: Bronze for NPS 2 and smaller; stainless steel for NPS 2-1/2 and larger.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
6. Configuration: Designed for horizontal, straight-through flow.
7. Accessories:

    a. ValvesNPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
    b. ValvesNPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

D. Beverage-Dispensing-Equipment Backflow Preventers:

1. Standard: ASSE 1022.
2. Operation: Continuous-pressure applications.
3. Size: NPS 1/4 or NPS 3/8.
4. Body: Stainless steel.
5. End Connections: Threaded.

E. Dual-Check-Valve Backflow Preventers:

1. Standard: ASSE 1024.
2. Operation: Continuous-pressure applications.
3. Body: Bronze with union inlet.

F. Carbonated-Beverage-Dispenser, Dual-Check-Valve Backflow Preventers:

1. Standard: ASSE 1032.
2. Operation: Continuous-pressure applications.
3. Size: NPS 1/4 or NPS 3/8.
4. Body: Stainless steel.
5. End Connections: Threaded.

G. Reduced-Pressure-Detector, Fire-Protection, Backflow-Preventer Assemblies:

1. Standard: ASSE 1047 and is FM Global approved or UL listed.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 12 psig maximum, through middle third of flow range.
4. Body: Stainless steel.
5. End Connections: Flanged.
6. Configuration: Designed for horizontal, straight-through flow.
7. Accessories:

    a. Valves: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
    b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
    c. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

H. Double-Check, Detector-Assembly Backflow Preventers:

1. Standard: ASSE 1048 and is FM Global approved or UL listed.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 5 psig maximum, through middle third of flow range.
4. Body: Stainless steel.
5. End Connections: Flanged.
6. Configuration: Designed for horizontal, straight-through flow.
7. Accessories:

    a. Valves: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
    b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

I. Hose-Connection Backflow Preventers:

1. Standard: ASSE 1052.
2. Operation: Up to 10-foot head of water back pressure.
3. Inlet Size: NPS 1/2 or NPS 3/4.
4. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
5. Capacity: At least 3-gpm flow.

J. Backflow-Preventer Test Kits :

1. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.5 WATER PRESSURE-REDUCING VALVES

A. Water Regulators :

1. Standard: ASSE 1003.
2. Pressure Rating: Initial working pressure of 150 psig.
3. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
4. Valves for Booster Heater Water Supply: Include integral bypass.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

B. Water-Control Valves :

1. Description: Pilot-operated, diaphragm-type, single-seated, main water-control valve.
2. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
3. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
   a. Pattern: Globe-valve design.
   b. Trim: Stainless steel.
4. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

2.6 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Type: Y-pattern globe valve with two readout ports and memory-setting indicator.
2. Body: Brass or bronze.
3. Size: Same as connected piping, but not larger than NPS 2.
4. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Cast-Iron Calibrated Balancing Valves :

1. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
2. Size: Same as connected piping, but not smaller than NPS 2-1/2.

C. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

D. Memory-Stop Balancing Valves :

1. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 2 or smaller.
4. Body: Copper alloy.
5. Port: Standard or full port.

6. Ball: Chrome-plated brass.
7. Seats and Seals: Replaceable.
8. End Connections: Solder joint or threaded.
9. Handle: Vinyl-covered steel with memory-setting device.

2.7 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices :

1. Standard: ASSE 1017.
2. Pressure Rating: 125 psig.
3. Type: Thermostatically controlled, water mixing valve.
4. Material: Bronze body with corrosion-resistant interior components.
5. Connections: Threaded union inlets and outlet.
6. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
7. Tempered-Water Setting: 110 F

B. Primary, Thermostatic, Water Mixing Valves :

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

   a. Armstrong International, Inc.
   b. Lawler Manufacturing Company, Inc.
   c. Leonard Valve Company.
   d. Powers.
   e. Symmons Industries, Inc.
   f. Zurn Industries, LLC.

2. Standard: ASSE 1017.

3. Pressure Rating: 125 psigminimum unless otherwise indicated.
4. Type: Exposed-mounted, 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. Tempered-Water Setting: 110 F
9. Tempered-Water Design Flow Rate: 145 gpm

C. Manifold, Thermostatic, Water Mixing-Valve Assemblies:

1. Description: Factory-fabricated, exposed-mounted, thermostatically controlled, water mixing-valve assembly in three-valve parallel arrangement.
2. Large-Flow Parallel: Thermostatic, water mixing valve and downstream-pressure regulator with pressure gages on inlet and outlet.
3. Intermediate-Flow Parallel: Thermostatic, water mixing valve and downstream-pressure regulator with pressure gages on inlet and outlet.
4. Small-Flow Parallel: Thermostatic, water mixing valve.
5. Thermostatic Mixing Valves: Comply with ASSE 1017. Include check stops on hot- and cold-water inlets and shutoff valve on outlet.

6. Water Regulator(s): Comply with ASSE 1003. Include pressure gage on inlet and outlet.
7. Pressure Rating: 125 psig minimum unless otherwise indicated.

D. Individual-Fixture, Water Tempering Valves:

1. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
2. Pressure Rating: 125 psig minimum unless otherwise indicated.
3. Body: Bronze body with corrosion-resistant interior components.
4. Temperature Control: Adjustable.
5. Inlets and Outlet: Threaded.
6. Finish: Rough or chrome-plated bronze.
7. Tempered-Water Setting: 110 F

E. Primary Water Tempering Valves:

1. Standard: ASSE 1017, thermostatically controlled, water tempering valve, listed as tempering valve.
2. Pressure Rating: 125 psig minimum unless otherwise indicated.
3. Body: Bronze.
4. Temperature Control: Manual.
5. Inlets and Outlet: Threaded.

2.8 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: 0.033 inch.
    b. Strainers NPS 2-1/2 to NPS 4: 0.062 inch.
    c. Strainers NPS 5 and Larger: 0.125 inch.

6. Drain: Factory-installed, hose-end drain valve.

2.9 OUTLET BOXES

A. Clothes Washer Outlet Boxes:

1. Mounting: Recessed.
2. Material and Finish: Enameled-steel, epoxy-painted-steel, or plastic box and faceplate.

3. Faucet: Combination valved fitting or separate hot- and cold-water valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
4. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.
5. Drain: NPS 2 standpipe and P-trap for direct waste connection to drainage piping.
6. Inlet Hoses: Two 60-inch-long, rubber household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.
7. Drain Hose: One 48-inch-long, rubber household clothes washer drain hose with hooked end.

B. Icemaker Outlet Boxes <Insert drawing designation if any>:

1. Mounting: Recessed.
2. Material and Finish: Enameled-steel, epoxy-painted-steel, or plastic box and faceplate.
3. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
4. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.10 HOSE STATIONS

A. Single-Temperature-Water Hose Stations:

1. Standard: ASME A112.18.1.
2. Cabinet: Stainless-steel enclosure with exposed valve handle, hose connection, and hose rack. Include thermometer in front.
3. Hose-Rack Material: Stainless steel.
4. Body Material: Bronze.
5. Body Finish: Rough bronze.
6. Mounting: Wall, with reinforcement.
7. Supply Fittings: NPS 3/4 gate, globe, or ball valve and check valve and NPS 3/4 copper, water tubing. Omit check valve if check stop is included with fitting.
8. Hose: Manufacturer's standard, for service fluid, temperature, and pressure; 50 feet long.
9. Nozzle: With hand-squeeze, on-off control.
10. Vacuum Breaker:

    a. Integral or factory-installed, nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
    b. Garden-hose thread complying with ASME B1.20.7 on outlet.

B. Hot- and Cold-Water Hose Stations:

1. Standard: ASME A112.18.1.
2. Faucet Type: Blending valve.
3. Cabinet: Stainless-steel enclosure with exposed valve handles, hose connection, and hose rack. Include thermometer in front.
4. Hose-Rack Material: Stainless steel.

5. Body Material: Bronze.
6. Body Finish: Rough bronze.
7. Mounting: Wall, with reinforcement.
8. Supply Fittings: Two NPS 3/4 gate, globe, or ball valves and check valves and NPS 3/4 copper, water tubing. Omit check valves if check stops are included with fitting.
9. Hose: Manufacturer's standard, for service fluid, temperature, and pressure; 50 feet long.
10. Nozzle: With hand-squeeze, on-off control.
11. Vacuum Breaker: Integral or factory-installed, nonremovable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052; and garden-hose thread complying with ASME B1.20.7 on outlet.

2.11 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 (2760-kPa) minimum CWP.
3. Size: NPS 3/4 (DN 20).
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.

B. Gate-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: NPS 3/4 (DN 20).
4. Body: ASTM B 62 bronze.
5. Inlet: NPS 3/4 (DN 20) threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

C. Stop-and-Waste Drain Valves <Insert drawing designation if any>:

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig (1380-kPa) minimum CWP or Class 125.
3. Size: NPS 3/4 (DN 20).
4. Body: Copper alloy or ASTM B 62 bronze.
5. Drain: NPS 1/8 (DN 6) side outlet with cap.

2.12 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters :

1. Standard: ASSE 1010 or PDI-WH 201.
2. Type: Metal bellows or Copper tube with piston.
3. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.13 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating and Temperature: 125-psig (860-kPa) minimum pressure rating at 140 deg F (60 deg C).
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 1/2 (DN 15) minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.
2. Pressure Rating: 150-psig (1035-kPa) minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 (DN 10) minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

2.14 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:

1. Standard: ASSE 1018.
2. Pressure Rating: 125 psig (860 kPa) minimum.
3. Body: Bronze.
4. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
5. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
6. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Device:

1. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 (DN 10) minimum, trap makeup connection.
2. Size: NPS 1-1/4 (DN 32) minimum.
3. Material: Chrome-plated, cast brass.

2.15 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems:

1. Standard: ASSE 1044.

2. Piping: NPS 3/4, ASTM B 88, Type L (DN 20, ASTM B 88M, Type B); copper, water tubing.
3. Cabinet: Recessed-mounted steel box with stainless-steel cover.
4. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.

    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.

5. Vacuum Breaker: ASSE 1001.
6. Number Outlets: Eight.
7. Size Outlets: NPS 1/2 (DN 15).

2.16 SPECIALTY VALVES

A. Comply with requirements for general-duty metal valves in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."

2.17 FLEXIBLE CONNECTORS

A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig (1380 kPa).
2. End Connections NPS 2 (DN 50) and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged copper alloy.

B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig (1380 kPa).
2. End Connections NPS 2 (DN 50) and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged steel nipple.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install Y-pattern strainers for water on supply side of each control valve and pump.

B. Install air vents at high points of water piping.

3.2 FIELD QUALITY CONTROL

A. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

B. Prepare test and inspection reports.

END OF SECTION 221119

SECTION 221316

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.

B. Related Section:

1. Section 221313 "Facility Sanitary Sewers" for sanitary sewerage piping and structures outside the building.

1.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 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.

PART 2 - PRODUCTS

2.1 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.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, class.

B. Gaskets: ASTM C 564, rubber.

2.3 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.

C. Heavy-Duty, Hubless-Piping Couplings:

1. Standards: ASTM C 1277 and ASTM C 1540.
2. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 STAINLESS-STEEL PIPE AND FITTINGS

A. Pipe and Fittings: ASME A112.3.1, drainage pattern with socket and spigot ends.

B. Internal Sealing Rings: Elastomeric gaskets shaped to fit socket groove.

2.5 ABS 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 ABS Pipe: ASTM D 2661, Schedule 40.

C. Cellular-Core ABS Pipe: ASTM F 628, Schedule 40.

D. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.

E. Solvent Cement: ASTM D 2235.

2.6 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. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.

D. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

E. Adhesive Primer: ASTM F 656.

F. Solvent Cement: ASTM D 2564.

2.7 COPPER TUBE AND FITTINGS

A. Copper 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 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.

D. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.8 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. 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. 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.

4. 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.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

B. Provide a minimum of 6" sand bedding below all below grade piping. Provide backfill free of boulders larger than two (2") inches. Compact and test all backfill according to astm compaction standards or provide pea gravel backfill.

C. Provide a minimum trench width of not less than 1.5 times the pipe outside diameter plus 12 inches for all below grade piping.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

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 at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

I. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

J. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

K. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for all piping.
2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

L. 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."

M. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

N. Plumbing Specialties:

1. Install backwater valves in sanitary waste gravity-flow piping. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
3. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 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 hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

C. 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.

D. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Unshielded, non-pressure transition couplings.

3.5 VALVE INSTALLATION

A. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
3. Install backwater valves in accessible locations.
4. Comply with requirements for backwater valve specified in Section 221319 "Sanitary Waste Piping Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. 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.

7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. 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. 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 stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 2 (DN 50): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
2. NPS 3 (DN 80): 96 inches (2400 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 (DN 100): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
4. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.

I. Install supports for vertical stainless-steel piping every 10 feet (3 m).

J. Install hangers for ABS and PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.

2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 and NPS 8 (DN 150 and DN 200): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
5. NPS 10 and NPS 12 (DN 250 and DN 300): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.

K. Install supports for vertical ABS and PVC piping every 48 inches (1200 mm).

L. 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.

M. Install supports for vertical copper tubing every 10 feet.

N. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Install horizontal backwater valves with cleanout cover flush with floor.
6. Comply with requirements for backwater valves cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
7. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 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.

3.8 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 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. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.

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

E. Do not expose ABS or PVC piping to direct sunlight for more than 30 days. If construction delays are encountered, provide cover to portions of piping exposed to direct sunlight.

3.10 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Exposed ABS and 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. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
3. Copper DWV tube, copper drainage fittings, and soldered joints.
4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
    a. When used in plenum returns piping to be completely enclosed in insulation that meets the flame spread index of not more than 25 and a smoke-developed index of not more than 50.
5. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.
    a. When used in plenum returns piping to be completely enclosed in insulation that meets the flame spread index of not more than 25 and a smoke-developed index of not more than 50.

C. Underground, soil, waste, and vent piping shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
4. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.

END OF SECTION 221316

SECTION 221319

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backwater valves.
2. Cleanouts.
3. Floor drains.
4. Trench drains.
5. Channel drainage systems.
6. Air-admittance valves.
7. Roof flashing assemblies.
8. Miscellaneous sanitary drainage piping specialties.
9. Flashing materials.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for grease interceptors.

1.3 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 BACKWATER VALVES

A. Horizontal, Cast-Iron Backwater Valves:

1. Standard: ASME A112.14.1.
2. Size: Same as connected piping.
3. Body: Cast iron.
4. Cover: Cast iron with bolted or threaded access check valve.
5. End Connections: Hub and spigot or hubless.
6. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang open for airflow unless subject to backflow condition.
7. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

B. Drain-Outlet Backwater Valves:

1. Size: Same as floor drain outlet.
2. Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
3. Check Valve: Removable ball float.
4. Inlet: Threaded.
5. Outlet: Threaded or spigot.

2.2 CLEANOUTS

A. Exposed Cast-Iron Cleanouts:

1. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
2. Size: Same as connected drainage piping
3. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
4. Closure: Countersunk or raised-head, brass plug.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Floor Cleanouts:

1. Standard: ASME A112.36.2M for adjustable housing cleanout.
2. Size: Same as connected branch.
3. Type: Adjustable housing.
4. Body or Ferrule: Cast iron.
5. Clamping Device: Required.
6. Outlet Connection: Spigot.
7. Closure: Brass plug with straight threads and gasket.
8. Adjustable Housing Material: Cast iron with threads.
9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
10. Frame and Cover Shape: Round.
11. Top Loading Classification: Heavy Duty.
12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Standard: ASME A112.36.2M. Include wall access.
2. Size: Same as connected drainage piping.
3. Body: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
4. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.3 FLOOR DRAINS

A. Cast-Iron Floor Drains (FD)

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

a. Josam Company.

b. MIFAB, Inc.

c. Smith, Jay R. Mfg. Co.

d. Watts; a Watts Water Technologies company.

e. Zurn Industries, LLC.

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Top of Body and Strainer Finish: Nickel bronze.
6. Top Shape: Square
7. Dimensions of Top or Strainer: 6"
8. Trap Features: Provide with trap guard.

2.4 TRENCH DRAINS

A. Trench Drains :

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

   a. Jay R. Smith Mfg. Co.
   b. Josam Company.
   c. MIFAB, Inc.
   d. Watts; a Watts Water Technologies company.
   e. Zurn Industries, LLC.

2. Standard: ASME A112.6.3 for trench drains.
3. Material: Ductile or gray iron.
4. Flange: Anchor.
5. Clamping Device: Required.
6. Outlet: Bottom.
7. Grate Material: Ductile iron or gray iron.
8. Grate Finish: Painted.
9. Top Loading Classification: Heavy Duty.
10. Trap Material: Cast iron.
11. Trap Pattern: Standard P-trap.

2.5 CHANNEL DRAINAGE SYSTEMS

A. Stainless-Steel Channel Drainage Systems :

1. ASME A112.3.1, Stainless-Steel Channel Drainage Systems:

2. Non-ASME A112.3.1, Stainless-Steel Channel Drainage Systems:

3. Type: Modular system of stainless-steel channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.

    a. Standard: ASME A112.3.1, for trench drains.
    b. Channel Sections: Interlocking-joint, stainless-steel with level invert.

    c. Grates: Manufacturer's designation "heavy duty," with slots or perforations, and of width and thickness that fit recesses in channels.

        1) Material: Stainless steel.
        2) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.

    d. Covers: Solid stainless steel, of width and thickness that fit recesses in channels, and of lengths indicated.
    e. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
    f. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

4. Type: Modular system of stainless-steel channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.

    a. Channel Sections: Interlocking-joint, stainless steel with level invert.

    b. Grates: Manufacturer's designation "heavy duty," with slots or perforations, and of width and thickness that fit recesses in channels.

        1) Material: Stainless steel.
        2) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.

    c. Covers: Solid stainless steel, of width and thickness that fit recesses in channels, and of lengths indicated.
    d. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
    e. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

B. Polymer-Concrete Channel Drainage Systems:

1. Narrow, Sloped-Invert, Polymer-Concrete Channel Drainage Systems:

2. Narrow, Level-Invert, Polymer-Concrete Channel Drainage Systems:

3. Wide, Level-Invert, Polymer-Concrete Channel Drainage Systems:

4. Type: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.

    a. Channel Sections: Narrow, interlocking-joint, sloped-invert, polymer-concrete modular units with end caps. Include rounded bottom, with built-in invert slope of 0.6 percent and with outlets in number, sizes, and locations indicated. Include extension sections necessary for required depth.

        1) Dimensions: 4-inch inside width. Include number of units required to form total lengths indicated.
        2) Frame: Gray-iron or galvanized steel for grates.

    b. Grates: Manufacturer's designation "heavy duty," with slots or perforations, and of width and thickness that fit recesses in channel sections.

    c. Covers: Solid ductile or gray iron, of width and thickness that fit recesses in channel sections, and of lengths indicated.
    d. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
    e. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.
    f. Channel Sections: Narrow, interlocking-joint, precast, polymer-concrete modular units with end caps. Include rounded bottom, with level invert and with NPS 4 outlets in number and locations indicated.
        1) Frame: Gray-iron or galvanized steel for grates.

    g. Grates: Manufacturer's designation "heavy duty," with slots or perforations, and of width and thickness that fit recesses in channel sections.

    h. Covers: Solid ductile or gray iron, of width and thickness that fit recesses in channel sections, and of lengths indicated.
    i. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
    j. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.
    k. Channel Sections: Wide, interlocking-joint, precast, polymer-concrete modular units with end caps. Include flat or rounded bottom, with level invert and with outlets in number, sizes, and locations indicated.

    l. Grates: Manufacturer's designation "heavy duty," with slots or perforations, and of width and thickness that fit recesses in channel sections.

    m. Covers: Solid ductile or gray iron, of width and thickness that fit recesses in channel sections, and of lengths indicated.
    n. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
    o. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

2.6 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Description: Manufactured assembly made of 6.0-lb/sq. ft., 0.0938-inch-thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

a. Low-Silhouette Vent Cap: With vandal-proof vent cap.

2.7 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

B. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

2.8 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Fasteners: Metal compatible with material and substrate being fastened.

C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

D. Solder: ASTM B 32, lead-free alloy.

E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

B. 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.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

H. Install deep-seal traps on floor drains and other waste outlets.

I. 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.

J. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

K. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

L. Install vent caps on each vent pipe passing through roof.

M. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.

1. Above-Floor Installation: Set unit with bottom resting on floor, unless otherwise indicated.
2. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor.
3. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.
4. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.

N. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 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. Grease Interceptors: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 07 62 00 "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.4 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each grease interceptor.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.5 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 224213.13

COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Water closets.
2. Flushometer valves.
3. Toilet seats.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 FLOOR-MOUNTED, BOTTOM-OUTLET WATER CLOSETS

A. Water Closets: Floor mounted, bottom outlet, top spud.

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

a. American Standard America.
b. Crane Plumbing, L.L.C.
c. Kohler Co.
d. TOTO USA, INC.
e. Zurn Industries, LLC.
f. Sloan

2. Bowl:

a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
b. Material: Vitreous china.
c. Type: Siphon jet.
d. Style: Flushometer valve.
e. Height: Standard
f. Rim Contour: Elongated.
g. Water Consumption: 1.28 gal. per flush.
h. MaP Score: 1,000
i. Spud Size and Location: NPS 1-1/2; top.
j. Color: White.

3. Bowl-to-Drain Connecting Fitting: ASME A112.4.3.

4. Coordinate "Toilet Seat" Subparagraph with "Toilet Seats" Article.

2.2 WALL-MOUNTED WATER CLOSETS

A. Water Closets: Wall mounted, top spud, accessible.

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

a. American Standard America.
b. Crane Plumbing, L.L.C.
c. Kohler Co.
d. TOTO USA, INC.
e. Zurn Industries, LLC.
f. Sloan

2. Bowl:

a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
b. Material: Vitreous china.
c. Type: Siphon jet.
d. Style: Flushometer valve.
e. Height: Standard.
f. Rim Contour: Elongated.
g. Water Consumption: 1.28 gal. per flush.
h. MaP Score: 1,000
i. Spud Size and Location: NPS 1-1/2; top.

3. Support:

a. Standard: ASME A112.6.1M.
b. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture.

2.3 FLUSHOMETER VALVES

A. Lever-Handle, Diaphragm Flushometer Valves:

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

   a. Sloan Valve Company.
   b. Zurn Industries, LLC.

2. Standard: ASSE 1037.
3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Consumption: 1.28 gal. per flush.
8. Minimum Inlet: NPS 1.
9. Minimum Outlet: NPS 1-1/4.

2.4 TOILET SEATS

A. Toilet Seats

1. Standard: IAPMO/ANSI Z124.5.
2. Material: Plastic.
3. Type: Commercial (Standard).
4. Shape: Elongated rim, open front.
5. Hinge Material: Non-corroding metal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.

B. Support Installation:

1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
2. Use carrier supports with waste-fitting assembly and seal.

3. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.

C. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
4. Install actuators in locations that are easy for people with disabilities to reach, with handle or operator no higher than 36".
5. Coordinate valve location with grab bars in ADA stalls. Valves to provide a minimum of 2" clear between top of valve and grab bar. Coordinate with architectural plans for grab bar heights (typically 36").

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

F. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.2 CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.3 ADJUSTING

A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

3.4 CLEANING AND PROTECTION

A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed water closets and fittings.

C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.13

SECTION 224216.13 - COMMERCIAL LAVATORIES & SINKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Lavatories
2. Sinks
3. Sink faucets.
4. Laminar-flow, faucet-spout outlets.
5. Supply fittings.
6. Waste fittings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sinks.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sinks to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.

2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 LAVATORIES

A. Sinks LAV-A: Vitreous China, wall mounted, ADA compliant. Zurn Z5320-PED or equal by below manufacturers.

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

a. Advance Tabco.
b. Elkay Manufacturing Co.
c. Just Manufacturing.
d. Sloan

2. Fixture:

a. Standard: ASME A112.19.3/CSA B45.4.
b. Type: Ledge back
c. Number of Compartments: One
d. Overall Dimensions: 20 ¾ x18 ¼.
e. Material: Vitreous China
f. Holes: Three, Centered.
g. Mounting Type: Wall mounted

2.2 SINKS

A. Sinks S-1, S-2: Stainless steel, counter mounted. Elkay LR1316(S-1), Elkay LRAD331965PD(S-2) or equal by below manufacturers.

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

a. Advance Tabco.
b. Elkay Manufacturing Co.
c. Just Manufacturing.

2. Fixture:

a. Standard: ASME A112.19.3/CSA B45.4.
b. Type: Ledge back.
c. Number of Compartments: One
d. Overall Dimensions: 18 ½ x18 ½.
e. Material: 304, 18-8 Stainless Steel, 18 Gauge
f. Holes: No holes
g. Mounting Type: Undermount

2.3 SINK FAUCETS

A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for faucet-spout materials that will be in contact with potable water.

B. Sink Faucets for S-1, S-2: Manual type, deck-mounted with 8" centers, lever handles with color-coded indexes, ADA compliant

1. Commercial, Polished Chrome. Centurion 111E-BN or equal by below manufacturers.

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

1) American Standard America.
2) Bradley Corporation.
3) Chicago Faucets; Geberit Company.
4) Delta Faucet Company.
5) Eljer, Inc.
6) Elkay Manufacturing Co.
7) GROHE America, Inc.
8) Just Manufacturing.
9) Kohler Co.
10) Moen Incorporated.
11) Price Pfister, Inc.
12) Sloan
13) Speakman Company.
14) T & S Brass and Bronze Works, Inc.
15) Zurn Industries, LLC.

2. Standard: ASME A112.18.1/CSA B125.1.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole-punching; coordinate outlet with spout and sink receptor.
4. Body Type: Deck-mounted, 8" center, chrome-plated brass body with integral shanks.
5. Body Material: General-duty, brushed nickel
6. Finish: Brushed
7. Maximum Flow Rate: 1.5 gpm.
8. Handle(s): Lever handles with color-coded (red and blue) index buttons.
9. Mounting Type: Deck, exposed.
10. Spout Type: Stationary type.

C. Lavatory Faucets for L-2: Automatic-type, battery-powered, electronic-sensor-operated, mixing, solid-brass valve. Chicago Faucet 116.430.AB.1 or equal by below manufacturers.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. American Standard America.
b. Bradley Corporation.
c. Chicago Faucets; Geberit Company.
d. Delta Faucet Company.
e. Eljer, Inc.
f. Elkay Manufacturing Co.
g. GROHE America, Inc.
h. Just Manufacturing.

i. Kohler Co.
j. Moen Incorporated.
k. Price Pfister, Inc.
l. Sloan
m. Speakman Company.
n. T & S Brass and Bronze Works, Inc.
o. Zurn Industries, LLC.

2. Standards: ASME A112.18.1/CSA B125.1 and UL 1951.
3. 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.
4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole-punching; coordinate outlet with spout and fixture receptor.
5. Body Type: Single hole.
6. Body Material: Commercial, chrome plated, vandal resistant
7. Finish: Chrome plated
8. Maximum Flow Rate: 0.5 gpm
9. Mounting Type: Under-mount
10. Spout: Rigid type.
11. Spout Outlet: Aerator.

2.4 LAMINAR-FLOW, FAUCET-SPOUT OUTLETS

A. NSF Standard: Comply with NSF/ANSI 61 Annex 61, "Drinking Water System Components - Health Effects," for faucet-spout-outlet materials that will be in contact with potable water.

B. Description: Chrome-plated brass, faucet-spout outlet that produces non-aerating, laminar stream. Include external or internal thread that mates with faucet outlet for attachment to faucets where indicated and flow-rate range that includes flow of faucet.

2.5 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Loose key.

2.6 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.

C. Trap:

1. Size: NPS 1-1/2.
2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated brass or steel wall flange.
3. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless-steel tube to wall; and stainless-steel wall flange.

2.7 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Non-shrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.

B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install sinks level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-hung sinks.

C. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.

D. Set floor-mounted sinks in leveling bed of cement grout.

E. Install water-supply piping with stop on each supply to each sink faucet.

1. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."
2. Install stops in locations where they can be easily reached for operation.

F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

G. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

H. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS

A. Connect sinks 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 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After completing installation of sinks, inspect and repair damaged finishes.

B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed sinks and fittings.

D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.16

SECTION 230516

EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Slip-joint, packed expansion joints.
2. Metal, compensator packless expansion joints.
3. Rubber union connector packless expansion joints.
4. Flexible-hose packless expansion joints.
5. Externally pressurized metal-bellows packless expansion joints.
6. Alignment guides and anchors.
7. Pipe loops and swing connections.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Delegated-Design Submittal: For each anchor and alignment guide, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
3. Alignment Guide Details: Detail field assembly and attachment to building structure.
4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 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.

PART 2 - PRODUCTS

2.1 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.

2.2 PACKED EXPANSION JOINTS

A. Slip-Joint Packed Expansion Joints:

1. Standard: ASTM F 1007.
2. Material: Carbon steel with asbestos-free PTFE packing.
3. Design: With internal guide and injection ports for repacking under full system pressure. Housing shall be furnished with drain ports and lifting ring. Include drip connection if used for steam piping.
4. Configuration: Single joint class(es), unless otherwise indicated.
5. Slip Tube for sizes NPS 1-1/2 through NPS 16: Schedule 80.
6. Sliding Surface: 2 mil thick chrome finish.
7. End Connections: Flanged or welded ends to match piping system.

2.3 PACKLESS EXPANSION JOINTS

A. Metal, Compensator Packless Expansion Joints:

1. Minimum Pressure Rating: 150 psig, unless otherwise indicated.
2. Description: Totally enclosed, externally pressurized, multi-ply bellows isolated from fluid flow by an internal pipe sleeve and external housing.
3. Joint Axial Movement: 2 inches of compression and 1/2 inch of extension.
4. Configuration for Copper Tubing: Multi-ply, phosphor-bronze bellows with copper pipe ends.

    a. End Connections for Copper Tubing NPS 2 and Smaller: Solder joint or threaded.
    b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4: Threaded.

5. Configuration for Steel Piping: Multi-ply, stainless-steel bellows; steel-pipe end connections; and carbon-steel shroud.

a. End Connections for Steel Pipe NPS 2 and Smaller: Threaded.
b. End Connections for Steel Pipe NPS 2-1/2 to NPS 4: Welded.

B. Rubber Union Connector Expansion Joints:

1. Material: Twin reinforced-rubber spheres with external restraining cables.
2. Minimum Pressure Rating: 150 psig at 170 deg F, unless otherwise indicated.
3. End Connections for NPS 2 and Smaller: Threaded.

C. Flexible-Hose Packless Expansion Joints:

1. 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.
2. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
3. 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.

4. 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.

5. 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.

6. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6: Carbon-steel fittings with welded 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.

D. Externally Pressurized Metal-Bellows Packless Expansion Joints:

1. Minimum Pressure Rating: 150 psig, unless otherwise indicated.
2. Description:

a. Totally enclosed, externally pressurized, multi-ply, stainless-steel bellows isolated from fluid flow by an internal pipe sleeve.
b. Carbon-steel housing.
c. Drain plugs and lifting lug for the NPS 3 and larger.
d. Bellows shall have operating clearance between the internal pipe sleeves and the external shrouds.
e. Joints shall be supplied with a built-in scale to confirm the starting position and operating movement.
f. Joint Axial Movement: 4 inches of compression and of extension.

3. Permanent Locking Bolts: Set locking bolts to maintain joint lengths during installation. Temporary welding tabs that are removed after installation in lieu of locking bolts are not acceptable.
4. End Connection Configuration: Flanged; one raised, fixed and one floating flange.

2.4 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.

PART 3 - EXECUTION

3.1 EXPANSION JOINT INSTALLATION

A. Install expansion joints of sizes matching sizes of piping in which they are installed.

B. Install packed-type expansion joints with packing suitable for fluid service.

C. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION

A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.

B. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.

C. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.

D. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install one guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four 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.

END OF SECTION 230516

SECTION 230517

SLEEVES AND SLEEVE SEALS FOR HVAC 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.

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. 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: Stainless steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, 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: Non-shrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 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. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

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.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

a. Piping Smaller Than NPS 6: Cast-iron wall sleeves.
b. Piping NPS 6 and Larger: Cast-iron wall sleeves.

2. Exterior Concrete Walls below Grade:

a. Piping : Cast-iron wall sleeves with sleeve-seal system].

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

a. Piping : Cast-iron wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:

a. Piping : PVC-pipe sleeves.

5. Interior Partitions:
a. Piping : Galvanized-steel-sheet sleeves.

END OF SECTION 230517

SECTION 230519

METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bimetallic-actuated thermometers.
2. Liquid-in-glass thermometers.
3. Thermowells.
4. Dial-type pressure gages.
5. Gage attachments.
6. Pitot-tube flowmeters.
7. Turbine flowmeters.
8. Venturi flowmeters.
9. Impeller-turbine, thermal-energy meters.

1.2 ACTION SUBMITTALS

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

B. Wiring Diagrams: For power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

A. Standard: ASME B40.200.

B. Case: Liquid-filled and sealed type(s); stainless steel with 3-inch nominal diameter.

C. Dial: Non-reflective aluminum with permanently etched scale markings and scales in deg F

D. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.

E. Connector Size: 1/2 inch, with ASME B1.1 screw threads.

F. Stem: 0.25 or 0.375 inch in diameter; stainless steel.

G. Window: plastic.

H. Ring: Stainless steel.

I. Element: Bimetal coil.

J. Pointer: Dark-colored metal.

K. Accuracy: Plus or minus 1 percent of scale range.

2.2 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Standard: ASME B40.200.
2. Case: Cast aluminum; 7-inch nominal size unless otherwise indicated.
3. Case Form: Adjustable angle unless otherwise indicated.
4. Tube: Glass with magnifying lens and blue[or red] organic liquid.
5. Tube Background: Non-reflective aluminum with permanently etched scale markings graduated in deg F.
6. Window: plastic.
7. Stem: Aluminum and of length to suit installation.

    a. Design for Air-Duct Installation: With ventilated shroud.
    b. Design for Thermowell Installation: Bare stem.

8. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
9. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

B. Plastic-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Standard: ASME B40.200.
2. Case: Plastic; 7-inch nominal size unless otherwise indicated.
3. Case Form: Adjustable angle unless otherwise indicated.
4. Tube: Glass with magnifying lens and blue organic liquid.
5. Tube Background: Non-reflective aluminum with permanently etched scale markings graduated in deg F.
6. Window: plastic.
7. Stem: Aluminum and of length to suit installation.

    a. Design for Air-Duct Installation: With ventilated shroud.
    b. Design for Thermowell Installation: Bare stem.

8. Connector: 1-1/4 inches, with ASME B1.1 screw threads.

9. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.3 DUCT-THERMOMETER MOUNTING BRACKETS

A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

2.4 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.
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.

2.5 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Standard: ASME B40.100.
2. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
4. 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.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Non-reflective aluminum with permanently etched scale markings graduated in psi.
7. Pointer: Dark-colored metal.
8. Window: plastic.
9. Ring: Metal.
10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

B. Direct-Mounted, Plastic-Case, Dial-Type Pressure Gages:

1. Standard: ASME B40.100.
2. Case: Sealed type; plastic; 4-1/2-inch nominal diameter.

3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
4. 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.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Non-reflective aluminum with permanently etched scale markings graduated in psi.
7. Pointer: Dark-colored metal.
8. Window: plastic.
9. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

C. Remote-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Standard: ASME B40.100.
2. Case: Liquid-filled type; cast aluminum or drawn steel; 4-1/2-inch nominal diameter with back flange and holes for panel mounting.
3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
4. 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.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Non-reflective aluminum with permanently etched scale markings graduated in psi.
7. Pointer: Dark-colored metal.
8. Window: plastic.
9. Ring: Metal.
10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.6 GAGE ATTACHMENTS

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

B. Siphons: Loop-shaped section of stainless-steel pipe with NPS 1/4 or NPS 1/2 pipe threads.

C. Valves: Brass ball, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

2.7 FLOWMETERS

A. Pitot-Tube Flowmeters:

1. Description: Flowmeter with sensor and indicator.
2. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
3. Sensor: Insertion type; for inserting probe into piping and measuring flow directly in gallons per minute.

    a. Design: Differential-pressure-type measurement for [oil] [water] <Insert fluid>.
    b. Construction: Stainless-steel probe of length to span inside of pipe, with integral transmitter and direct-reading scale.
    c. Minimum Pressure Rating: 150 psig.

d. Minimum Temperature Rating: 250 deg F.

4. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
5. Integral Transformer: For low-voltage power connection.
6. Accuracy: Plus or minus 2 percent.
7. Display: Shows rate of flow, with register to indicate total volume in gallons.
8. Operating Instructions: Include complete instructions with each flowmeter.

B. Turbine Flowmeters:

1. Description: Flowmeter with sensor and indicator.
2. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
3. Sensor: Impeller turbine; for inserting into pipe fitting or for installing in piping and measuring flow directly in gallons per minute.

a. Design: Device or pipe fitting with inline turbine and integral direct-reading scale for water.
b. Construction: Bronze or stainless-steel body, with plastic turbine or impeller.
c. Minimum Pressure Rating: 150 psig.
d. Minimum Temperature Rating: 180 deg F.

4. Indicator: Hand-held meter; either an integral part of sensor or a separate meter.
5. Accuracy: Plus or minus 1-1/2 percent.
6. Display: Shows rate of flow, with register to indicate total volume in gallons.
7. Operating Instructions: Include complete instructions with each flowmeter.

C. Venturi Flowmeters:

1. Description: Flowmeter with calibrated flow-measuring element, hoses or tubing, fittings, valves, indicator, and conversion chart.
2. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
3. Sensor: Venturi-type, calibrated, flow-measuring element; for installation in piping.

a. Design: Differential-pressure-type measurement for water.
b. Construction: Bronze, brass, or factory-primed steel, with brass fittings and attached tag with flow conversion data.
c. Minimum Pressure Rating: 250 psig.
d. Minimum Temperature Rating: 250 deg F.
e. End Connections for NPS 2 and Smaller: Threaded.
f. End Connections for NPS 2-1/2 and Larger: Flanged or welded.
g. Flow Range: Flow-measuring element and flowmeter shall cover operating range of equipment or system served.

4. Permanent Indicators: Meter suitable for wall or bracket mounting, calibrated for connected flowmeter element, and having 6-inch-diameter, or equivalent, dial with fittings and copper tubing for connecting to flowmeter element.

a. Scale: Gallons per minute.
b. Accuracy: Plus or minus 1 percent between 20 and 80 percent of scale range.

5. Portable Indicators: Hand-held, differential-pressure type, calibrated for connected flowmeter element and having two 12-foot hoses, with carrying case.

    a. Scale: Gallons per minute.
    b. Accuracy: Plus or minus 2 percent between 20 and 80 percent of scale range.

6. Display: Shows rate of flow, with register to indicate total volume in gallons.
7. Conversion Chart: Flow rate data compatible with sensor.
8. Operating Instructions: Include complete instructions with each flowmeter.

2.8 THERMAL-ENERGY METERS

A. Impeller-Turbine, Thermal-Energy Meters:

1. Description: System with strainer, flow sensor, temperature sensors, transmitter, indicator, and connecting wiring.
2. Flow Sensor: Impeller turbine with corrosion-resistant-metal body and transmitter; for installing in piping.

    a. Design: Total thermal-energy measurement.
    b. Minimum Pressure Rating: 150 psig.
    c. Minimum Temperature Range: 40 to 250 deg F (5 to 121 deg C).

3. Temperature Sensors: Insertion-type transducer.
4. Indicator: Solid-state, integrating-type meter with integral battery pack; for wall mounting.

    a. Data Output: Six-digit electromechanical counter with readout in kilowatts per hour or British thermal units.
    b. Battery Pack: Five-year lithium battery.

5. Accuracy: Plus or minus 1 percent.
6. Display: Visually indicates total fluid volume in gallons and thermal-energy flow in kilowatts per hour or British thermal units.
7. Strainer: Full size of main line piping.
8. Operating Instructions: Include complete instructions with each thermal-energy meter system.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending one-third of pipe diameter 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 duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.

H. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

I. Install remote-mounted pressure gages on panel.

J. Install valve and snubber in piping for each pressure gage for fluids (except steam).

K. Install valve and syphon fitting in piping for each pressure gage for steam.

L. Install flow indicators in piping systems in accessible positions for easy viewing.

M. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.

N. Install flowmeter elements in accessible positions in piping systems.

O. Install differential-pressure-type flowmeter elements, with at least minimum straight lengths of pipe, upstream and downstream from element according to manufacturer's written instructions.

P. Install permanent indicators on walls or brackets in accessible and readable positions.

Q. Install connection fittings in accessible locations for attachment to portable indicators.

R. Mount thermal-energy meters on wall if accessible; if not, provide brackets to support meters.

S. Install thermometers in the following locations:

1. Inlet and outlet of each hydronic zone.
2. Inlet and outlet of each hydronic boiler.
3. Two inlets and two outlets of each chiller.
4. Inlet and outlet of each hydronic coil in air-handling units.
5. Two inlets and two outlets of each hydronic heat exchanger.
6. Inlet and outlet of each thermal-storage tank.
7. Outside-, return-, supply-, and mixed-air ducts.

T. Install pressure gages in the following locations:

1. Discharge of each pressure-reducing valve.
2. Inlet and outlet of each chiller chilled-water and condenser-water connection.

3. Suction and discharge of each pump.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

B. Connect flowmeter-system elements to meters.

C. Connect flowmeter transmitters to meters.

D. Connect thermal-energy meter transmitters to meters.

3.3 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

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

3.4 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each hydronic zone shall be[one of] the following:

1. Liquid-filled, bimetallic-actuated type.
2. Industrial-style, liquid-in-glass type.

B. Thermometers at inlet and outlet of each hydronic boiler shall be one of the following:

1. Liquid-filled, bimetallic-actuated type.
2. Industrial-style, liquid-in-glass type.

C. Thermometers at inlets and outlets of each chiller shall be one of the following:

1. Liquid-filled, bimetallic-actuated type.
2. Industrial-style, liquid-in-glass type.

D. Thermometers at inlet and outlet of each hydronic coil in air-handling units and built-up central systems shall be one of the following:

1. Liquid-filled, bimetallic-actuated type.
2. Industrial-style, liquid-in-glass type.

E. Thermometers at inlets and outlets of each hydronic heat exchanger shall be one of the following:

1. Liquid-filled, bimetallic-actuated type.
2. Industrial-style, liquid-in-glass type.

F. Thermometers at inlet and outlet of each hydronic heat-recovery unit shall be[one of] the following:

1. Liquid-filled, bimetallic-actuated type.
2. Industrial-style, liquid-in-glass type.

G. Thermometers at inlet and outlet of each thermal-storage tank shall be one of the following:

1. Liquid-filled, bimetallic-actuated type.
2. Industrial-style, liquid-in-glass type.

H. Thermometers at outside-, return-, supply-, and mixed-air ducts shall be one of the following:

1. Liquid-filled, bimetallic-actuated type.
2. Industrial-style, liquid-in-glass type.

I. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Chilled-Water Piping: 0 to 100 deg F.

B. Scale Range for Condenser-Water Piping: 0 to 150 deg F.

C. Scale Range for Heating, Hot-Water Piping: 20 to 240 deg F.

D. Scale Range for Steam and Steam-Condensate Piping: 20 to 240 deg F.

E. Scale Range for Air Ducts: 0 to 150 deg F.

3.6 PRESSURE-GAGE SCHEDULE

A. Pressure gages at discharge of each pressure-reducing valve shall be the following:

1. Liquid-filled, direct-mounted, metal case.

B. Pressure gages at inlet and outlet of each chiller chilled-water and condenser-water connection shall be the following:

1. Liquid-filled, direct-mounted, metal case.

C. Pressure gages at suction and discharge of each pump shall be the following:

1. Liquid-filled, direct-mounted, metal case.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Hydronic Piping: 0 to 100 psi.

B. Scale Range for Steam Piping: 0 to 160 psi.

3.8 FLOWMETER SCHEDULE

A. Flowmeters for Chilled-Water Piping: Pitot-tube, Turbine, or Venturi type.

B. Flowmeters for Condenser-Water Piping: Pitot-tube, Turbine, or Venturi type.

C. Flowmeters for Heating, Hot-Water Piping: Pitot-tube, Turbine, or Venturi type.

D. Flowmeters for Steam and Steam-Condensate Piping: Venturi type.

3.9 THERMAL-ENERGY METER SCHEDULE

A. Thermal-Energy Meters: Impeller-turbine type.

END OF SECTION 230519

SECTION 230529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Equipment supports.

1.2 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 HVAC 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 and obtain approval from authorities having jurisdiction.

1.3 ACTION SUBMITTALS

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

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.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 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

2.1 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. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. 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 copper-coated steel.

2.2 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.

2.3 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.

2.4 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.

2.5 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.6 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, non-shrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Non-staining, non-corrosive, and non-gaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 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. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

G. 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.

H. Install lateral bracing with pipe hangers and supports to prevent swaying.

I. 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.

J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

K. 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.

L. 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.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 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.

3.4 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.

3.5 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 architectural specifications.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 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 stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. 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.

K. 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.

L. 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.

M. 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.

N. 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.

O. 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.

P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

SECTION 230548

VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 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.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

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.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Field quality-control reports.

1.4 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

2.1 PERFORMANCE REQUIREMENTS

A. Wind-Restraint Loading:

1. Ultimate Design Wind Speed: 115 MPH
2. Building Classification Category: II.
3. Minimum 10 lb/sq. ft. multiplied by maximum area of HVAC component projected on vertical plane normal to wind direction, and 45 degrees either side of normal.

B. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: D.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: II.

    a. Component Importance Factor: 1.0.

2.2 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: Waffle pattern.
5. Infused nonwoven cotton or synthetic fibers.
6. Load-bearing metal plates adhered to pads.

2.3 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.

2.4 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.

2.5 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.
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.6 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.

2.7 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.

2.8 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.

2.9 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 psigon 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 re-insertable 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Kinetics Noise Control, Inc.
2. Mason Industries, Inc.
3. Vibration Mountings & Controls, Inc.

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

1. B-line, an Eaton business.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.

B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

C. 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.

D. 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.

E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

F. 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.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.2 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 033000 "Cast-in-Place Concrete."] [Section 033053 "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 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

D. Equipment Restraints:

1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
3. Install 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 pre-stressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. 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.

3.3 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 232113 "Hydronic Piping" for piping flexible connections.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post-connection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.5 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 230548

SECTION 230553

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: White.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. 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.
6. Fasteners: Stainless-steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: White.
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.

C. 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.

D. 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, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: White.

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-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.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.

B. Pre-tensioned Pipe Labels: Pre-coiled, semi-rigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. 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.

2.4 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: White.

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-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. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 EQUIPMENT LABEL INSTALLATION

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

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified by architect.

B. 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.

C. Pipe Label Color Schedule:

1. Chilled-Water Piping: White letters on a safety-green background.
2. Condenser-Water Piping: White letters on a safety-green background.
3. Heating Water Piping: White letters on a safety-green background.
4. Refrigerant Piping: Black letters on a safety-orange background.
5. Low-Pressure Steam Piping: White letters on a safety-purple background.
6. High-Pressure Steam Piping: White letters on a safety-purple background.
7. Steam Condensate Piping: White letters on a safety-purple background.

3.4 DUCT LABEL INSTALLATION

A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:

1. Blue: For cold-air supply ducts.
2. Yellow: For hot-air supply ducts.
3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.

B. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

END OF SECTION 230553

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

a. Constant-volume air systems.
b. Dual-duct systems.
c. Variable-air-volume systems.

2. Balancing Hydronic Systems:

a. Constant-volume air systems.
b. Variable-volume systems.

1.3 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 entity engaged to perform TAB Work.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 15 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. Certified TAB reports.

E. Sample report forms.

F. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.5 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC or NEBB.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC or NEBB.
2. TAB Technician: Employee of the TAB contractor and who is certified by AABC or NEBB as a TAB technician.

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 approved by Owner.

D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

F. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.6 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TAB SPECIALISTS

A. Subject to compliance with requirements, engage one of the following:

1. Certified Test and Balance.
2. Bonneville Test and Balance.
3. BTC Test and Balance.
4. Diamond Test and Balance.
5. R and S Analysis
6. Intermountain Test and Balance
7. Test and Balancing, Inc.
8. Independent Test and Balance

3.2 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

F. Examine test reports specified in individual system and equipment Sections.

G. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

H. Examine terminal units; such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

I. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

J. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

K. Examine operating safety interlocks and controls on HVAC equipment.

L. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Automatic temperature-control systems are operational.
3. Equipment and duct access doors are securely closed.
4. Balance, smoke, and fire dampers are open.
5. Isolating and balancing valves are open and control valves are operational.
6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
7. Windows and doors can be closed so indicated conditions for system operations can be met.

3.4 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", or ASHRAE 111-1988, or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems".

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 same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 23 33 00 "Air Duct Accessories."
3. Install and join new insulation that matches removed materials. 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.

D. All instruments used by the Contractor shall have been calibrated within the previous 12 months. The final balance report shall contain copies of calibration documents showing calibration tolerances, date of calibration and calibrating firm.

E. Air and water quantities shall be balanced to within 5% of the quantities shown.

F. Balance air flow at duct branch damper with outlet dampers full open.

G. Test, adjust and record fan RPM to design requirements, record initial and final readings.

H. Test and record motor amps, initial and final readings.

I. Make pitot tube traverse readings of main ducts and obtain design CFM for supply, return and outside air systems by adjusting fans and dampers.

J. Test and record systems static pressures, suction and discharge; record initial and final readings.

K. Test and adjust each terminal unit.

L. Check and record inlet static pressures and modulation limit CFM values, initial and final readings after adjustments.

M. The Balancing Contractor shall have a Controls Mechanic available at all times to assist the balancing personnel in adjusting control devices.

N. Clearly mark the final position of all dampers, diffusers, reheat boxes, etc. with permanent identification material, neatly applied so as to be easily read and understood.

O. Confusing or illegible markings shall be removed and reapplied as directed by the Project Manager.

P. All mechanical HVAC systems, air and water, shown on the plans shall be tested and adjusted To design flow. If heating air flow values are different than cooling, provide certification that Heating CFM values are within design.

Q. Replace sheaves and drives where required to meet design conditions.

R. Copies of a formal balance report shall be prepared and submitted for inclusion in the Operation And Maintenance Manuals. The report shall contain a complete, legible schedule of:

1. All equipment outlets/inlets and their respective flows
2. Pitot tube traverse readings and associated calculations
3. Reheat box settings, GPM and CFM
4. Box static pressures at inlets
5. Box CFM limits (maximum and minimum)

6. Status of each pump and fan, including RPM, AMPS, suction and discharge static pressures, and flow rates.
7. A set of master plans shall be bound with the schedules (11" x 17" maximum) identifying the location of each inlet/outlet and device tested.
8. Calibration documents

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Section 23 31 13 "Metal Ducts."

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

a. Where sufficient spaces in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:

a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.

b. Measure static pressure directly at the fan outlet or through the flexible connection.
c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

a. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
6. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.

a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
3. Re-measure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.7 PROCEDURES FOR DUAL-DUCT SYSTEMS

A. Verify that the cooling coil is capable of full-system airflow, and set mixing boxes at full-cold airflow position for fan volume.

B. Measure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate controls of mixing boxes and to overcome resistance in the ducts and outlets downstream from mixing boxes.

1. If insufficient static pressure exists, increase airflow at the fan.

C. Test and adjust the constant-volume mixing boxes as follows:

1. Verify both hot and cold operations by adjusting the thermostat and observing changes in air temperature and volume.
2. Verify sufficient inlet static pressure before making volume adjustments.
3. Adjust mixing boxes to indicated airflows within specified tolerances. Measure airflow by Pitot-tube traverse readings or by measuring static pressure at mixing-box taps if provided by mixing-box manufacturer.

D. Do not over pressurize ducts.

E. Re-measure static pressure in both hot and cold ducts at the end of the longest duct run to determine that sufficient static pressure exists to operate controls of mixing boxes and to overcome resistance in the ducts and outlets downstream from mixing boxes.

F. Adjust variable-air-volume, dual-duct systems in the same way as constant-volume, dual-duct systems; adjust maximum- and minimum-airflow setting of each mixing box.

3.8 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the

terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.

3. Measure total system airflow. Adjust to within indicated airflow.
4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.

    a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.

6. Re-measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

    a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

7. Measure static pressure at the most critical terminal unit and adjust the maximum static-pressure set point at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit. Notify engineer if pressure is above the allowable range before making the adjustment.
8. Record final fan-performance data.

3.9 PROCEDURES FOR HYDRONIC SYSTEMS.

A. Command all systems into full cooling or heating mode (Valves may not be 100% open). Pumps VFCs shall modulate in automatic control to meet the static pressure set point. When pump speed is stable take measurements.

1. Balance circuit setters for the end of line three-way valves to design flow.
2. Measure and record water flows at each air handler coil.
3. Measure flow of each pump.

3.10 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.11 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:

1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

B. 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. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the air flow rates and water 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.
4. Balance each air outlet.

3.12 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING HYDRONIC SYSTEMS.

A. Balancing procedures shall ensure that balancing valves are open as much as possible to minimize system pressure drop

B. Constant speed primary boiler pumps.

1. Set flow rate to rated GPM.

C. Variable speed secondary hot water and chilled water systems.

1. All two way valves are pressure-independent self-flow regulating valves which are not manually balanced.
2. With controls contractor, set systems into automatic control with the VFCs regulating system pressure to maintain the static pressure set point. Close enough two-way control valves closer to the pumps so the system flow rate is approximately 50% of design. All other valves shall be 100% open.

a. Balance flow rates through coils with 3-way valves. Adjust BAS DP set point lower if required so at least one of the balancing valves is 100% open.
b. Verify that the system DP set point is adequate to provide rated flow through a small sample of the 2-way valves.

3. Chilled water system:

a. With the two-way valve closed and the three-way chilled water valves 100% open;

1) Balance the flows through the three coils served by three-way valves. (One balancing valve shall be 100% open).
2) Determine the minimum pump speed required to maintain the minimum chiller evaporator flow rate. Contractor shall program the minimum pump speed in the VFC at 10% above this flow rate.

b. With the chilled water pump at minimum speed, change the three-way valves to the closed position and verify that the system flow rate is the same or greater than when the control valves are in the open position.

3.13 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 5 percent.
2. Air Outlets and Inlets: Plus or minus 5 percent.
3. Heating-Water Flow Rate: Plus or minus 5 percent.
4. Cooling-Water Flow Rate: Plus or minus 5 percent.

3.14 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.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. 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 contractor.
3. Project name.
4. Project location.
5. Engineer's name and address.
6. Contractor's name and address.
7. Report date.
8. Signature of TAB supervisor who certifies the report.
9. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
10. 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.

11. Nomenclature sheets for each item of equipment.
12. Data for terminal units, including manufacturer's name, type, size, and fittings.
13. Notes to explain why certain final data in the body of reports vary from indicated values.
14. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Air-Terminal-Device Reports:

1. Unit Data:

    a. System and air-handling unit identification.
    b. Location and zone.
    c. Apparatus used for test.
    d. Area served.
    e. Make.

f. Number from system diagram.
g. Type and model number.
h. Size.
i. Effective area in sq. ft.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm (L/s).
b. Air velocity in fpm (m/s).
c. Preliminary air flow rate as needed in cfm (L/s).
d. Preliminary velocity as needed in fpm (m/s).
e. Final air flow rate in cfm (L/s).
f. Final velocity in fpm (m/s).
g. Space temperature in deg F (deg C).

F. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

a. System and air-handling-unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm (L/s).
b. Entering-water temperature in deg F (deg C).
c. Leaving-water temperature in deg F (deg C).
d. Water pressure drop in feet of head or psig (kPa).
e. Entering-air temperature in deg F (deg C).
f. Leaving-air temperature in deg F (deg C).

G. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.15 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.

2. Check the following for each system:

    a. Measure airflow of at least 10 percent of air outlets.
    b. Measure water flow of at least 10 percent of terminals.
    c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
    d. Verify that balancing devices are marked with final balance position.
    e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Engineer.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Owner.
3. Engineer shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

3.16 ADDITIONAL TESTS

A. The Test and Balance Contractor shall include an extended warranty of 90 days after the completion of the project, during which time the Owner may request a recheck or re-set of any outlet, inlet, control, or mechanical unit.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 23 05 93

SECTION 230713

DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulating the following duct services:
   1. Indoor, concealed supply and outdoor air.
   2. Indoor, exposed supply and outdoor air.

B. Related Sections:
   1. Section 230719 "HVAC Piping Insulation."
   2. Section 233113 "Metal Ducts" for duct liners.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
   1. For adhesives and sealants, documentation including printed statement of VOC content.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

1.5 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.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor 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. Provide fiberglass faced duct wrap Type IV with factory applied flame retardant foil reinforced Kraft facing FRK-25, U.L. Label.

2.2 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. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
   b. Eagle Bridges - Marathon Industries; 225.
   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.Mon-Eco Industries, Inc.; 22-25.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
   b. Vimasco Corporation; 749..
2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

2.4 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.

2.5 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. ABI, Ideal Tape Division; 428 AWF ASJ.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
   c. Compac Corporation; 104 and 105.
   d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. ABI, Ideal Tape Division; 488 AWF.
   b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
   c. Compac Corporation; 120.
   d. Venture Tape; 3520 CW.
2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.6 SECUREMENTS

A. Bands:
1. Products: Subject to compliance with requirements, provide one of the following:
   a. ITW Insulation Systems; Gerrard Strapping and Seals.
   b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing seal or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:
1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated.
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) AGM Industries, Inc.; CWP-1.
      2) GEMCO; CD.
      3) Midwest Fasteners, Inc.; CD.
      4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) AGM Industries, Inc.; CHP-1.
      2) GEMCO; Cupped Head Weld Pin.
      3) Midwest Fasteners, Inc.; Cupped Head.
      4) Nelson Stud Welding; CHP.
3. 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. Comply with the following requirements:
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
      2) GEMCO; Perforated Base.
      3) Midwest Fasteners, Inc.; Spindle.

b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
c. Spindle: Copper- or zinc-coated, low-carbon steel, aluminum, or stainless steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) GEMCO; Nylon Hangers.
      2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
   b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
   c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
5. Self-Sticking-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. Comply with the following requirements:
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
      2) GEMCO; Peel & Press.
      3) Midwest Fasteners, Inc.; Self Stick.
   b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   c. Spindle: Copper- or zinc-coated, low-carbon steel, aluminum, or stainless steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
   d. Adhesive-backed base with a peel-off protective cover.
6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel, aluminum, or stainless-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. Products: Subject to compliance with requirements, provide one of the following:
      1) AGM Industries, Inc.; RC-150.
      2) GEMCO; R-150.
      3) Midwest Fasteners, Inc.; WA-150.
      4) Nelson Stud Welding; Speed Clips.
   b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1) GEMCO.
   2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. C & F Wire.

2.7 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.

C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
   1. Verify that systems to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Duct insulation wrap in exposed corridors shall be canvas covered and painted to match existing duct insulation.

B. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

C. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

D. 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.

E. Install insulation with longitudinal seams at top and bottom of horizontal runs.

F. Install multiple layers of insulation with longitudinal and end seams staggered.

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.

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. Adhere insulation with 4" strips of Insulation Bonding Adhesive at 8" on center.
   3. Overlap jacket longitudinal seams at least 2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c. Adhere insulation with 4" strips of Insulation Bonding Adhesive at 8" on center. Cover longitudinal joints with 3-inch wide strips, of same material as insulation jacket.
      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.

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.

3.4 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 078413 "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 078413 "Penetration Firestopping."

3.5 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.

3.6 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 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 (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
    b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) 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 over-compress 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 (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) 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 (10 deg C) at 18-foot (5.5-m) 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 (75 mm).

5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) 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- (150-mm-) wide strips of same material used to insulate duct.

Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) 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 (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
    b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) 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 over-compress 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 (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) 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 (10 deg C) at 18-foot (5.5-m) 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 (75 mm).

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- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. 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.

D. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.8 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 078413 "Penetration Firestopping."

3.9 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "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. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.10 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.

3.11 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:
1. Indoor, supply, return and outdoor air.

B. Items Not Insulated:
1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
2. Factory-insulated flexible ducts.
3. Flexible connectors.
4. Vibration-control devices.
5. Factory-insulated access panels and doors.

3.12 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, round, rectangular, and flat-oval, supply-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

END OF SECTION 230713

SECTION 230719

HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulating the following HVAC piping systems:
   1. Heating hot-water piping, indoors and outdoors.

B. Related Sections:

   1. Section 23 07 13 "Duct Insulation."

1.2 ACTION SUBMITTALS

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

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail attachment and covering of heat tracing inside insulation.
   3. Detail insulation application at pipe expansion joints for each type of insulation.
   4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
   5. Detail removable insulation at piping specialties.
   6. Detail application of field-applied jackets.
   7. Detail application at linkages of control devices.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 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 and inspecting 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

2.1 INSULATION MATERIALS

A. Products shall not contain asbestos, lead, mercury, or mercury compounds.

B. 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.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Block Insulation: ASTM C 552, Type I.
2. Special-Shaped Insulation: ASTM C 552, Type III.
3. Board Insulation: ASTM C 552, Type IV.
4. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
5. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 1290, Type I.

H. Mineral-Fiber, Preformed Pipe Insulation:

1. 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. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
2. Type II, 1200 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

I. Mineral-Fiber, Pipe Insulation Wicking System: Preformed pipe insulation complying with ASTM C 547, Type I, Grade A, with absorbent cloth factory-applied to the entire inside surface of preformed pipe insulation and extended through the longitudinal joint to

outside surface of insulation under insulation jacket. Factory apply a white, polymer, vapor-retarder jacket with self-sealing adhesive tape seam and evaporation holes running continuously along the longitudinal seam, exposing the absorbent cloth.

J. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.

2.2 INSULATING CEMENTS

A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

2.3 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. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. 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.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

F. PVC Jacket Adhesive: Compatible with PVC jacket.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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.

2.5 SEALANTS

A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
4. Color: White or gray.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

6. Sealants 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."

B. 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.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants 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."

C. ASJ Flashing Sealants, and Vinyl, PVDC, 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.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants 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."

2.6 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.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. PVDC Jacket for Indoor Applications: 4-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perm when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

6. PVDC Jacket for Outdoor Applications: 6-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perm when tested according to

ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.

7. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

8. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil face, fiberglass-reinforced scrim with kraft-paper backing.

C. 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. Adhesive: As recommended by jacket material manufacturer.
2. Color: Color-code jackets based on system. Color as selected by Architect.
3. 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.

D. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

1. Sheet and roll stock ready for shop or field sizing.
2. Finish and thickness are indicated in field-applied jacket schedules.
3. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
4. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
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.

E. Self-Adhesive Outdoor Jacket: 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with white aluminum-foil facing.

F. PVDC Jacket for Indoor Applications: 4-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

G. PVDC Jacket for Outdoor Applications: 6-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.

H. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

2.9 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. 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.

D. 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.

E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Width: 3 inches.
2. Film Thickness: 4 mils.
3. Adhesive Thickness: 1.5 mils.
4. Elongation at Break: 145 percent.
5. Tensile Strength: 55 lbf/inch in width.

F. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Width: 3 inches.
2. Film Thickness: 6 mils.
3. Adhesive Thickness: 1.5 mils.
4. Elongation at Break: 145 percent.
5. Tensile Strength: 55 lbf/inch in width.

2.10 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. 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

3.1 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.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe 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. 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] [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 pipe flanges and fittings.

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.

3.3 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 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."

3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the

insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. 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.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.6 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.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 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 Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube 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 polyolefin 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 polyolefin 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.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.9 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.

3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. 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.

C. 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.

D. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-pre-sized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install pre-sized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral-wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch-circumference limit allows for 2-inch-overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.10 FINISHES

A. Pipe 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."

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. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.11 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, 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 three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

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

3.12 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.13 INDOOR PIPING INSULATION SCHEDULE

A. Heating-Hot-Water Supply and Return, 200 Deg F and Below: Insulation shall be one of the following:

1. Cellular Glass: 2-1/2 inches thick.
2. Mineral-Fiber, Preformed Pipe, Type I: 2 inch thick.

B. Refrigerant Suction and Hot-Gas Flexible Tubing: Flexible elastomeric, 1 inch thick.

3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:
   1. PVC: 20 mils thick.

D. Piping, Exposed:
   1. PVC: 20 mils thick.

END OF SECTION 230719

SECTION 230923 - DIRECT DIGITAL CONTROL (DDC) SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. DDC system for monitoring and controlling of HVAC systems.

1.3 MEETINGS

A. Participate in weekly commissioning meetings.

B. Preinstallation Conference: Conduct conference at Project site.

1.4 SUBMITTALS

1. Provide detailed drawings and description of points that will be monitored and tied into the existing BMS. This will require gathering points from equipment manufacturer's PRIOR to generating submittals.

PART 2 - PRODUCTS

2.1 DDC SYSTEM MANUFACTURERS

1. System must match existing Siemens controls system used by the hospital. Communication protocol to be BACnet.

2.2 Products Furnished but Not Installed under This Section

A. Section 23 09 13.23 - Sensors and Transmitters
   1. Flow meters
   2. Flow switches
   3. Refrigerant pressure and temp sensor wells and sockets
   4. Hydronic temp sensor wells and sockets

B. Section 23 09 13.33 - Control Valves
   1. Control valves

2.3 Products Installed but Not Furnished under This Section

A. Section 23 09 13.23 - Sensors and Transmitters
   1. Duct static pressure sensors
   2. H2O Pressure Differential/Flow Switches

2.4 Products Not Furnished or Installed under but Integrated with the Work of This Section

A. Section - General
   1. Coordination Meeting: The Installer furnishing the DDC network shall meet with the Installer(s) furnishing each of the following products to coordinate details of the interface between these products and the DDC network. The Owner or his designated representative shall be present at this meeting. Each Installer shall provide the Owner and all other Installers with details of the proposed interface including PICS for BACnet equipment, hardware and software identifiers for the interface points, network identifiers, wiring requirements, communication speeds, and required network accessories. The purpose of this meeting shall be to insure there are no unresolved issues regarding the integration of these products into the DDC network. Submittals for these products shall not be approved prior to the completion of this meeting.

B. Section 23 36 00 - Air Terminal Units
   1. VAV boxes: VAV Terminal Units shall be furnished configured to accept control inputs from an external building automation system controller as specified in Section 23 09 93. Factory mounted safeties and other controls shall not interfere with this controller.

2.5 Related Sections

A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents.

B. The following sections constitute related work:
   1. Section 23 05 00 - Common Work Results for HVAC
   2. Section 23 20 00 - HVAC Piping and Pumps
   3. Section 23 30 00 - HVAC Air Distribution
   4. Section 23 40 00 - HVAC Air Cleaning Devices
   5. Section 23 50 00 - Central Heating Equipment
   6. Section 23 60 00 - Central Cooling Equipment
   7. Section 23 70 00 - Central HVAC Equipment
   8. Section 23 80 00 - Decentralized HVAC Equipment

2.6 Description

A. General: The control system shall consist of a high-speed, peer-to-peer network of DDC controllers, a control system server, and a web-based operator interface.

B. System software shall be based on a server/thin client architecture, designed around the open standards of web technology. The control system server shall be accessed using a Web browser over the control system network, the owner's local area network, and (at the owner's discretion) over the Internet.
   The intent of the thin-client architecture is to provide operators complete access to the control system via a Web browser. No special software other than a web browser shall be required to access graphics, point displays, and trends, configure trends, configure points and controllers, or to download programming into the controllers.

C. System shall use the BACnet protocol for communication to the operator workstation or web server and for communication between control modules. I/O points, schedules, setpoints, trends and alarms specified in 23 09 93 – "Sequence of Operations for HVAC Controls" shall be BACnet objects.

2.7 Quality Assurance

A. Installer and Manufacturer Qualifications
   1. Installer shall have an established working relationship with Control System Manufacturer.
   2. Installer shall have successfully completed Control System Manufacturer's control system training. Upon request, Installer shall present record of completed training including course outlines.

2.8 Codes and Standards

A. Work, materials, and equipment shall comply with the most restrictive of local, state, and federal authorities' codes and ordinances or these plans and specifications. As a minimum, the installation shall comply with the current editions in effect 30 days prior to the receipt of bids of the following codes:
   1. National Electric Code (NEC)
   2. International Building Code (IBC)
      a. Section 719 Ducts and Air Transfer Openings
      b. Section 907 Fire Alarm and Detection Systems
      c. Section 909 Smoke Control Systems
      d. Chapter 28 Mechanical
   3. International Mechanical Code (IMC)
   4. ANSI/ASHRAE Standard 135, BACnet - A Data Communication Protocol for Building Automation and Control Systems

2.9 System Performance

A. Performance Standards. System shall conform to the following minimum standards over network connections. Systems shall be tested using manufacturer's recommended hardware and software for operator workstation (server and browser for web-based systems).
   1. Graphic Display.A graphic with 20 dynamic points shall display with current data within 10 sec.
   2. Graphic Refresh.A graphic with 20 dynamic points shall update with current data within 8 sec. and shall automatically refresh every 15 sec.
   3. Configuration and Tuning Screens. Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within 6 sec.
   4. Object Command. Devices shall react to command of a binary object within 2 sec. Devices shall begin reacting to command of an analog object within 2 sec.
   5. Alarm Response Time. An object that goes into alarm shall be annunciated at the workstation within 45 sec.
   6. Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 sec. Select execution times consistent with the mechanical process under control.
   7. Performance. Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per sec. Select execution times consistent with the mechanical process under control.
   8. Multiple Alarm Annunciation. Each workstation on the network shall receive alarms within 5 sec of other workstations.
   9. Reporting Accuracy. System shall report values with minimum end-to-end accuracy listed in Table 1.
   10. Control Stability and Accuracy. Control loops shall maintain measured variable at setpoint within tolerances listed in Table 2.

2.10 Table-1

Reporting Accuracy

Measured Variable	**Reported Accuracy**
Space Temperature	±0.5°C (±1°F)
Ducted Air	±0.5°C (±1°F)
Outside Air	±1.0°C (±2°F)
Dew Point	±1.5°C (±3°F)
Water Temperature	±0.5°C (±1°F)
Delta-T	±0.15° (±0.25°F)
Relative Humidity	±5% RH

Water Flow	±2% of full scale
Airflow (terminal)	±10% of full scale (see Note 1)
Airflow (measuring stations)	±5% of full scale
Airflow (pressurized spaces)	±3% of full scale
Air Pressure (ducts)	±25 Pa (±0.1 in. w.g.)
Air Pressure (space)	±3 Pa (±0.01 in. w.g.)
Water Pressure	±2% of full scale (see Note 2)
Electrical	±1% of reading (see Note 3)
Carbon Monoxide (CO)	±5% of reading
Carbon Dioxide (CO2)	±50 ppm

Note 1: Accuracy applies to 10%–100% of scale
Note 2: For both absolute and differential pressure
Note 3: Not including utility-supplied meters

2.11 Table 2
Control Stability and Accuracy

Controlled Variable	**Control Accuracy**	**Range of Medium**
Air Pressure	±50 Pa (±0.2 in. w.g.) ±3 Pa (±0.01 in. w.g.)	0–1.5 kPa (0–6 in. w.g.) -25 to 25 Pa (-0.1 to 0.1 in. w.g.)
Airflow	±10% of full scale	
Space Temperature	±1.0°C (±2.0°F)	
Duct Temperature	±1.5°C (±3°F)	
Humidity	±5% RH	
Fluid Pressure	±10 kPa (±1.5 psi) ±250 Pa (±1.0 in. w.g.)	MPa (1–150 psi) 0–12.5 kPa (0–50 in. w.g.) differential

2.12 SEQUENCE OF OPERATIONS
1.A Variable Air Volume - Terminal Unit (typical of 3)

Run Conditions - Scheduled:
The unit shall run according to a user definable time schedule in the following modes:

- Occupied Mode: The unit shall maintain
  - A 75°F (adj.) cooling setpoint
  - A 70°F (adj.) heating setpoint.

- Unoccupied Mode (night setback): The unit shall maintain
  - A 85°F (adj.) cooling setpoint.
  - A 55°F (adj.) heating setpoint.

Alarms shall be provided as follows:

- High Zone Temp: If the zone temperature is greater than the cooling setpoint by a user definable amount (adj.).
- Low Zone Temp: If the zone temperature is less than the heating setpoint by a user definable amount (adj.).

Minimum Ventilation on Carbon Dioxide (CO2) Concentration:
When in the occupied mode, the controller shall measure the zone CO2 concentration and modulate the zone damper open on rising CO2 concentrations, overriding normal damper operation to maintain a CO2 setpoint of not more than 750 ppm (adj.).

Alarms shall be provided as follows:

- High Zone Carbon Dioxide Concentration: If the zone CO2 concentration is greater than 1000 ppm (adj.).

Zone Setpoint Adjust:
The occupant shall be able to adjust the zone temperature heating and cooling setpoints at the zone sensor.

Zone Optimal Start:
The unit shall use an optimal start algorithm for morning start-up. This algorithm shall minimize the unoccupied warm-up or cool-down period while still achieving comfort conditions by the start of scheduled occupied period.

Zone Unoccupied Override:
A timed local override control shall allow an occupant to override the schedule and place the unit into an occupied mode for an adjustable period of time. At the expiration of this time, control of the unit shall automatically return to the schedule.

Reversing Variable Volume Terminal Unit - Flow Control:
The unit shall maintain zone setpoints by controlling the airflow through one of the following:

Occupied:

- When zone temperature is greater than its cooling setpoint, the zone damper shall modulate between the minimum occupied airflow (adj.) and the maximum cooling airflow (adj.) until the zone is satisfied.
- When the zone temperature is between the cooling setpoint and the heating setpoint, the zone damper shall maintain the minimum required zone ventilation (adj.).
- When zone temperature is less than its heating setpoint, the controller shall enable heating to maintain the zone temperature at its heating setpoint. Additionally, if warm air is available from the AHU, the zone damper shall modulate between the minimum occupied airflow (adj.) and the maximum heating airflow (adj.) until the zone is satisfied.

Unoccupied:

- When the zone is unoccupied the zone damper shall control to its minimum unoccupied airflow (adj.).
- When the zone temperature is greater than its cooling setpoint, the zone damper shall modulate between the minimum unoccupied airflow (adj.) and the maximum cooling airflow (adj.) until the zone is satisfied.
- When zone temperature is less than its unoccupied heating setpoint, the controller shall enable heating to maintain the zone temperature at the setpoint. Additionally, if warm air is available from the AHU, the zone damper shall modulate between the minimum unoccupied airflow (adj.) and the auxiliary heating airflow (adj.) until the zone is satisfied.

Reheating Coil Valve:
The controller shall measure the zone temperature and modulate the reheating coil valve open on dropping temperature to maintain its heating setpoint.

When cold air is available from the AHU and there is no fan present in the box, the zone damper shall modulate to the minimum occupied airflow (adj.). If more heat is required, the zone damper shall modulate to the auxiliary heating airflow (adj.).

Reheating - High Discharge Air Temperature Limit:

The controller shall measure the discharge air temperature and limit reheating if the discharge air temperature is more than 95°F (adj.).

Discharge Air Temperature:
The controller shall monitor the discharge air temperature.

Alarms shall be provided as follows:
- High Discharge Air Temp: If the discharge air temperature is greater than 120°F (adj.).
- Low Discharge Air Temp: If the discharge air temperature is less than 40°F (adj.).

Zone Humidity:
The controller shall monitor the zone humidity.

Alarms shall be provided as follows:
- High Zone Humidity: If the zone humidity is greater than 70% (adj.).
- Low Zone Humidity: If the zone humidity is less than 5% (adj.).

Environmental Index:
When the zone is occupied, the controller will monitor the deviation of the zone temperature from the heating or cooling setpoint. The controller will also monitor the relative humidity and carbon dioxide concentration and compare them to comfort conditions. This data will be used to calculate a 0 - 100% Environmental Index which gives an indication of how well the zone is maintaining comfort. The controller will also calculate the percentage of time since occupancy began that the Environmental Index is 70% or higher. Optionally, a weighting factor can be configured to adjust the contribution of the zone to the rollup average index based upon the floor area of the zone, importance of the zone, or other static criteria.

	Hardware Points				Software Points						
Point Name	**AI**	**AO**	**BI**	**BO**	**AV**	**BV**	**Loop**	**Sched**	**Trend**	**Alarm**	**Show On Graphic**
Airflow	x								x		x
Discharge Air Temp	x								x		x
Zone Carbon Dioxide PPM	x								x		x
Zone Humidity	x								x		x
Zone Setpoint Adjust	x										x
Zone Temp	x								x		x
Reheating Valve		x							x		x
Zone Damper		x							x		x
Zone Override			x						x		x
Airflow Setpoint					x				x		x
Cooling Setpoint					x				x		x
DAT Heating Limit					x						
Environmental Index					x				x		
Heating Setpoint					x				x		x
Percent of Time Satisfied					x				x		

	Hardware Points				Software Points						
Point Name	**AI**	**AO**	**BI**	**BO**	**AV**	**BV**	**Loop**	**Sched**	**Trend**	**Alarm**	**Show On Graphic**
Zone Carbon Dioxide PPM Setpoint					x				x		x
Heating Mode						x			x		
Schedule								x			
High Discharge Air Temp										x	
High Zone Carbon Dioxide Concentration										x	
High Zone Humidity										x	
High Zone Temp										x	
Low Discharge Air Temp										x	
Low Zone Humidity										x	
Low Zone Temp										x	
Totals	**6**	**2**	**1**	**0**	**7**	**1**	**0**	**1**	**15**	**7**	**13**

Total Hardware (9) **Total Software (31)**

PART 3 - EXECUTION

3.1 DEMONSTRATION

A. Engage a factory-authorized service representative with complete knowledge of Project-specific system installed to train Owner's maintenance personnel to adjust, operate, and maintain DDC system.

B. Extent of Training:

1. Base extent of training on scope and complexity of DDC system indicated and training requirements indicated. Provide extent of training required to satisfy requirements indicated even if more than minimum training requirements are indicated.
2. Inform Owner of anticipated training requirements if more than minimum training requirements are indicated.

END OF SECTION 230923

SECTION 230923.11

CONTROL VALVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes control valves and actuators for DDC systems.

B. Related Requirements:

1. Section 230923 "Direct-Digital Control System for HVAC" control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.
2. Section 230933 "Electric and Electronic Control System for HVAC" for electric/electronic control valves and actuators in electric and electronic control systems.
3. Section 230993 "Sequence of Operations for HVAC Controls" for requirements that relate to Section 230923.11.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal:

1. Schedule and design calculations for control valves and actuators, including the following:

a. Flow at project design and minimum flow conditions.
b. Pressure differential drop across valve at project design flow condition.
c. Maximum system pressure differential drop (pump close-off pressure) across valve at project minimum flow condition.
d. Design and minimum control valve coefficient with corresponding valve position.
e. Maximum close-off pressure.
f. Leakage flow at maximum system pressure differential.
g. Torque required at worst case condition for sizing actuator.
h. Actuator selection indicating torque provided.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE 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. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.

C. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to size products where indicated as delegated design.

D. Ground Fault: Products shall not fail due to ground fault condition when suitably grounded.

E. Determine control valve sizes and flow coefficients by ISA 75.01.01.

F. Control valve characteristics and rangeability shall comply with ISA 75.11.01.

G. Selection Criteria:

1. Control valves shall be suitable for operation at following conditions:
   a. 50 psi and 200 F.

2. Fail positions unless otherwise indicated:
   a. Heating Hot Water: Open.

3. Minimum Cv shall be calculated at 10 percent of design flow, with a coincident pressure differential equal to the system design pump head.
4. In water systems, select modulating control valves at terminal equipment for a design Cv based on a pressure drop of 5 psig ((34 kPa)) at design flow unless otherwise indicated.

2.2 BALL-STYLE CONTROL VALVES

A. Ball Valves with Single Port and Characterized Disk:

1. Pressure Rating for NPS 1 ((DN 25)) and Smaller: Nominal 600 WOG.
2. Pressure Rating for NPS 1-1/2 (DN 38) through NPS 2 (DN 50): Nominal 400 WOG.
3. Close-off Pressure: 200 psig (1379 kPa).
4. Process Temperature Range: Zero to 212 deg F (Minus 18 to plus 100 deg C).
5. Body and Tail Piece: Cast bronze ASTM B 61, ASTM B 62, ASTM B 584, or forged brass with nickel plating.
6. End Connections: Threaded (NPT) ends.
7. Ball: Chrome-plated brass or bronze or 300 series stainless steel.
8. Stem and Stem Extension:

   a. Material to match ball.

b. Blowout-proof design.
c. Sleeve or other approved means to allow valve to be opened and closed without damaging the insulation or the vapor barrier seal.

9. Ball Seats: Reinforced PTFE.
10. Stem Seal: Reinforced PTFE packing ring with a threaded packing ring follower to retain the packing ring under design pressure with the linkage removed. Alternative means, such as EPDM O-rings, are acceptable if an equivalent cycle endurance can be demonstrated by testing.
11. Flow Characteristic: Equal percentage.

B. Ball Valves with Two Ports and Characterized Disk:

1. Pressure Rating for NPS 1 (DN 25) and Smaller: Nominal 600 WOG.
2. Pressure Rating for NPS 1-1/2 (DN 38) through NPS 2 (DN 50): Nominal 400 WOG.
3. Close-off Pressure: 200 psig (1379 kPa).
4. Process Temperature Range: Zero to 212 deg F (Minus 18 to plus 100 deg C).
5. Body and Tail Piece: Cast bronze ASTM B 61, ASTM B 62, ASTM B 584, or forged brass with nickel plating.
6. End Connections: Threaded (NPT) ends.
7. Ball: Chrome-plated brass or bronze or 300 series stainless steel.
8. Stem and Stem Extension:

a. Material to match ball.
b. Blowout-proof design.
c. Sleeve or other approved means to allow valve to be opened and closed without damaging the insulation or the vapor barrier seal.

9. Ball Seats: Reinforced PTFE.
10. Stem Seal: Reinforced PTFE packing ring with a threaded packing ring follower to retain the packing ring under design pressure with the linkage removed. Alternative means, such as EPDM O-rings, are acceptable if an equivalent cycle endurance can be demonstrated by testing.
11. Flow Characteristics for A-Port: Equal percentage.
12. Flow Characteristics for B-Port: Modified for constant common port flow.

C. Pressure-Independent Ball Valves NPS 2 (DN 50) and Smaller:

1. Performance:

a. Pressure Rating: 600 psig (4137 kPa) for NPS 1 (DN 25) and 400 psig (2528 kPa) for NPS 1-1/2 and NPS 2 (DN 38 and DN 50).
b. Close-off pressure of 200 psig (1379 kPa).
c. Process Temperature Range: Between zero to 212 deg F (minus 18 to plus 100 deg C).
d. Rangeability: 100 to 1.
e. Valve Authority: 100%

2. Integral Pressure Regulator: Located upstream of ball to regulate pressure, to maintain a constant pressure differential while operating within a pressure differential range of 5 to 50 psig ((34 to 345 kPa)).
3. Body: Forged brass, nickel plated, and with threaded ends.
4. Ball: Chrome-plated brass.

5. Stem and Stem Extension: Chrome-plated brass, blowout-proof design.
6. Stem sleeve or other approved means to allow valve to be opened and closed without damaging field-applied insulation and insulation vapor barrier seal.
7. Ball Seats: Reinforced PTFE.
8. Stem Seal: Reinforced PTFE packing ring stem seal with threaded packing ring follower to retain the packing ring under design pressure with the linkage removed. Alternative means, such as EPDM O-rings, are acceptable if equivalent cycle endurance can be achieved.
9. Flow Characteristic: Equal percentage.

2.3 ELECTRIC AND ELECTRONIC CONTROL VALVE ACTUATORS

A. Actuators for Hydronic Control Valves: Capable of closing valve against system pump shutoff head.

B. Actuators for Steam Control Valves: Shutoff against 1.5 times steam design pressure.

C. Position indicator and graduated scale on each actuator.

D. Type: Motor operated, with or without gears, electric and electronic.

E. Voltage: 24-V ac.

F. Deliver torque required for continuous uniform movement of controlled device from limit to limit when operated at rated voltage.

G. Function properly within a range of 85 to 120 percent of nameplate voltage.

H. Construction:

1. For Actuators Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
2. For Actuators from 100 to 400 W: Gears ground steel, oil immersed, shaft hardened steel running in bronze, copper alloy or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel or cast-aluminum housing.
3. For Actuators Larger Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.

I. Field Adjustment:

1. Spring Return Actuators: Easily switchable from fail open to fail closed in the field without replacement.
2. Gear Type Actuators: External manual adjustment mechanism to allow manual positioning when the actuator is not powered.

J. Two-Position Actuators: Single direction, spring return or reversing type.

K. Modulating Actuators:

1. Operation: Capable of stopping at all points across full range, and starting in either direction from any point in range.

2. Control Input Signal:

    a. Three Point, Tristate, or Floating Point: Clockwise and counter-clockwise inputs. One input drives actuator to open position and other input drives actuator to close position. No signal of either input remains in last position.
    b. Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for V dc 4- to 20-mA signals.
    c. Pulse Width Modulation (PWM): Actuator drives to a specified position according to pulse duration (length) of signal from a dry contact closure, triac sink, or source controller.
    d. Programmable Multi-Function:

        1) Control Input, Position Feedback, and Running Time: Factory or field programmable.
        2) Diagnostic: Feedback of hunting or oscillation, mechanical overload, mechanical travel, and mechanical load limit.
        3) Service Data: Include, at a minimum, number of hours powered and number of hours in motion.

L. Position Feedback:

1. Equip two-position actuators with limits switches or other positive means of a position indication signal for remote monitoring of open and close position.
2. Equip modulating actuators with a position feedback through current or voltage signal for remote monitoring.
3. Provide a position indicator and graduated scale on each actuator indicating open and closed travel limits.

M. Fail-Safe:

1. Where indicated, provide actuator to fail to an end position.
2. Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.
3. Batteries, capacitors, and other non-mechanical forms of fail-safe operation are acceptable only where uniquely indicated.

N. Integral Overload Protection:

1. Provide against overload throughout the entire operating range in both directions.
2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.

O. Valve Attachment:

1. Unless otherwise required for valve interface, provide an actuator designed to be directly coupled to valve shaft without the need for connecting linkages.
2. Attach actuator to valve drive shaft in a way that ensures maximum transfer of power and torque without slippage.
3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.

P. Temperature and Humidity:

1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of minus 20 to plus 120 deg F ((minus 29 to plus 49 deg C)).
2. Humidity: Suitable for humidity range encountered by application; minimum operating range shall be from 5 to 95 percent relative humidity, non-condensing.

Q. Enclosure:

1. Suitable for ambient conditions encountered by application.
2. NEMA 250, Type 2 for indoor and protected applications.
3. NEMA 250, Type 4 or Type 4X for outdoor and unprotected applications.
4. Provide actuator enclosure with heater and control where required by application.

R. Stroke Time:

1. Operate valve from fully closed to fully open within 60 seconds.
2. Operate valve from fully open to fully closed within 60 seconds.
3. Move valve to failed position within 15 seconds.
4. Select operating speed to be compatible with equipment and system operation.

S. Sound:

1. Spring Return: 62 dBA.
2. Non-Spring Return: 45 dBA.

PART 3 - EXECUTION

3.1 CONTROL VALVE APPLICATIONS

A. Control Valves:

1. Select from valves specified in "Control Valves" Article to achieve performance requirements and characteristics indicated while subjected to full range of system operation encountered.
2. General System,, Two-Way Applications Controlled by Flow: Ball valves with single port and characterized disk.

3.2 INSTALLATION, GENERAL

A. Furnish and install products required to satisfy most stringent requirements indicated.

B. Install products level, plumb, parallel, and perpendicular with building construction.

C. Properly support instruments, tubing, piping, wiring, and conduits to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a force.

D. Provide ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed

products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

E. Firestop penetrations made in fire-rated assemblies and seal penetrations made in acoustically rated assemblies.

F. Fastening Hardware:

1. Stillson wrenches, pliers, and other tools that will cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for assembling and tightening nuts.
2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

G. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

H. Corrosive Environments:

1. Use products that are suitable for environment to which they will be subjected.
2. If possible, avoid or limit use of materials in corrosive environments, including. but not limited to, the following:

    a. Laboratory exhaust airstreams.
    b. Process exhaust airstreams.

3. Use Type 316 stainless-steel tubing and fittings when in contact with a corrosive environment.
4. When conduit is in contact with a corrosive environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.
5. Where control devices are located in a corrosive environment and are not corrosive resistant from manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.3 ELECTRIC POWER

A. Furnish and install electrical power to products requiring electrical connections.

B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."

C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

D. Furnish and install raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

3.4 CONTROL VALVES

A. Install pipe reducers for valves smaller than line size. Position reducers as close to valve as possible but at distance to avoid interference and impact to performance. Install with manufacturer-recommended clearance.

B. Install flanges or unions to allow drop-in and -out valve installation.

C. Where indicated, install control valve with three-valve bypass manifold to allow for control valve isolation and removal without interrupting system flow by providing manual throttling valve in bypass pipe.

D. Install drain valves in piping upstream and downstream of each control valve installed in a three-valve manifold and for each control valve larger than NPS 2 ((DN 50)).

E. Install pressure temperature taps in piping upstream and downstream of each control valve larger than NPS 1 (DN 25).

F. Valve Orientation:

1. Where possible, install globe and ball valves installed in horizontal piping with stems upright and not more than 15 degrees off of vertical, not inverted.
2. Install valves in a position to allow full stem movement.
3. Where possible, install butterfly valves that are installed in horizontal piping with stems in horizontal position and with low point of disc opening with direction of flow.

G. Clearance:

1. Locate valves for easy access and provide separate support of valves that cannot be handled by service personnel without hoisting mechanism.
2. Install valves with at least 12 inches (300 mm) of clear space around valve and between valves and adjacent surfaces.

H. Threaded Valves:

1. Note internal length of threads in valve ends, and proximity of valve internal seat or wall, to determine how far pipe should be threaded into valve.
2. Align threads at point of assembly.
3. Apply thread compound to external pipe threads, except where dry seal threading is specified.
4. Assemble joint, wrench tight. Apply wrench on valve end as pipe is being threaded.

I. Flanged Valves:

1. Align flange surfaces parallel.
2. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

J. Connect electrical devices and components to electrical grounding system. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

K. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

L. Install engraved phenolic nameplate with valve identification on valve.

3.5 CHECKOUT PROCEDURES

A. Control Valve Checkout:

1. Check installed products before continuity tests, leak tests, and calibration.
2. Check valves for proper location and accessibility.
3. Check valves for proper installation for direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.
4. For pneumatic products, verify air supply for each product is properly installed.
5. For pneumatic valves, verify that pressure gauges are provided in each air line to valve actuator and positioner.
6. Verify that control valves are installed correctly for flow direction.
7. Verify that valve body attachment is properly secured and sealed.
8. Verify that valve actuator and linkage attachment are secure.
9. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
10. Verify that valve ball, disc, and plug travel are unobstructed.
11. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace the valve if leaks persist.

3.6 ADJUSTMENT, CALIBRATION, AND TESTING

A. Stroke and adjust control valves following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.

B. Stroke control valves with pilot positioners. Adjust valve and positioner following manufacturer's recommended procedure, so valve is 100 percent closed, 50 percent closed, and 100 percent open at proper air pressures.

C. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.

D. For control valves equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

END OF SECTION 230923.11

SECTION 232113

HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes pipe and fitting materials and joining methods for the following:

1. Hot-water heating piping.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Plastic pipe and fittings with solvent cement.
2. RTRP and RTRF with adhesive.
3. Pressure-seal fittings.
4. Chemical treatment.

B. Delegated-Design Submittal:

1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
2. Locations of pipe anchors and alignment guides and expansion joints and loops.
3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
4. Locations of and details for penetration and firestopping for fire and smoke-rated wall, floor, and ceiling assemblies.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:

1. 125 psig (kPa) at 200 deg F (93 deg C).
2. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B).

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K (ASTM B 88M, Type A).

C. DWV Copper Tubing: ASTM B 306, Type DWV.

D. Grooved, Mechanical-Joint, Wrought-Copper Fittings: ASME B16.22.

1. Grooved-End Copper Fittings: ASTM B 75 (ASTM B 75M), copper tube or ASTM B 584, bronze casting.
2. Grooved-End-Tube Couplings: Rigid pattern unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, EPDM gasket rated for minimum 230 deg F (110 deg C) for use with housing, and steel bolts and nuts.

E. Wrought-Copper Unions: ASME B16.22.

2.3 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.

E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.

F. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

G. Grooved Mechanical-Joint Fittings and Couplings:

1. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106/A 106M, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
2. Couplings: Ductile- or malleable-iron housing and EPDM gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

2.4 PLASTIC PIPE AND FITTINGS

A. CPVC Plastic Pipe: ASTM F 441/F 441M, with wall thickness as indicated in "Piping Applications" Article.

1. CPVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM F 438 for Schedule 40 pipe; ASTM F 439 for Schedule 80 pipe.

B. PVC Plastic Pipe: ASTM D 1785, with wall thickness as indicated in "Piping Applications" Article.

1. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.

C. Polypropylene Pipe with faser: ASTM F 2389 or CSA B137.11
1. Approved manufacturers:
   a. Aquatherm
   b. Pestan

2.5 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless otherwise indicated.

   a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

F. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Fusion welding: Comply with all manufacturer's requirements.

H. Solvent Cements for Joining Plastic Piping:

1. CPVC Piping: ASTM F 493.

a. CPVC solvent cement shall have a VOC content of 490 g/L or less.
b. Adhesive primer shall have a VOC content of 550 g/L or less.
c. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

a. PVC solvent cement shall have a VOC content of 510 g/L or less.
b. Adhesive primer shall have a VOC content of 550 g/L or less.
c. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

I. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.6 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings:

1. One-piece fitting with one threaded brass or copper insert and one solvent-cement-joint end of material and wall thickness to match plastic pipe material.

B. Plastic-to-Metal Transition Unions:

1. Brass or copper end, solvent-cement-joint end of material and wall thickness to match plastic pipe material, rubber gasket, and threaded union.

2.7 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. Description:

a. Standard: ASSE 1079.
b. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C).
c. End Connections: Solder-joint copper alloy and threaded ferrous.
d. Gasket: Garlock Gylon gasket

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, 3" and smaller shall be the following:

1. Type L (Type B), drawn-temper copper tubing, wrought-copper fittings, and brazed joints.
2. Polypropylene pipe, fusion welded. Fire wrap piping in return plenums as necessary.
3. Grooved, Mechanical-Joint, Wrought-Copper Fittings

3.2 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. 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. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 (DN 20) ball valve, and short NPS 3/4 (DN 20) threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to Section 230523.11 "Globe Valves for HVAC Piping," Section 230523.12 "Ball Valves for HVAC Piping," Section 230523.13 "Butterfly Valves for HVAC Piping," Section 230523.14 "Check Valves for HVAC Piping," and Section 230523.15 "Gate Valves for HVAC Piping."

Q. Install unions in piping, NPS 2 (DN 50) and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 (DN 65) and larger, at final connections of equipment and elsewhere as indicated.

S. Install shutoff valve immediately upstream of each dielectric fitting.

T. Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.

U. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.3 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges.

D. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.4 HANGERS AND SUPPORTS

A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.

B. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraints.

C. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet (6 m) long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet (6 m) or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4 (DN 20): Maximum span, 7 feet (2.1 m).
2. NPS 1 (DN 25): Maximum span, 7 feet (2.1 m).
3. NPS 1-1/2 (DN 40): Maximum span, 9 feet (2.7 m).
4. NPS 2 (DN 50): Maximum span, 10 feet (3 m).
5. NPS 2-1/2 (DN 65): Maximum span, 11 feet (3.4 m).
6. NPS 3 (DN 80) and Larger: Maximum span, 12 feet (3.7 m).

E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4 (DN 20): Maximum span, 5 feet (1.5 m); minimum rod size, 1/4 inch (6.4 mm).
2. NPS 1 (DN 25): Maximum span, 6 feet (1.8 m); minimum rod size, 1/4 inch (6.4 mm).
3. NPS 1-1/4 ((DN 32):)Maximum span, 7 feet (2.1 m); minimum rod size, 3/8 inch (10 mm).

4. NPS 1-1/2 (DN 40): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
5. NPS 2 (DN 50): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
6. NPS 2-1/2 (DN 65): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).
7. NPS 3 (DN 80) and Larger: Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).

F. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

G. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.

3.5 PIPE 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 pipe and fittings before assembly.

C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.

E. 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 unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

G. Plastic Piping Solvent-Cemented 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. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Pressure Piping: Join ASTM D 1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D 2855.
4. PVC Nonpressure Piping: Join according to ASTM D 2855.

H. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

I. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

3.6 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 230519 "Meters and Gages for HVAC Piping."

3.7 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of

specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."

5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 232113

SECTION 232116

HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes special-duty valves and specialties for the following:

1. Hot-water heating piping.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
2. Air-control devices.
3. Hydronic specialties.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. ASME Compliance: Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:

1. 125 psig (kPa) at 200 deg F (93 deg C).
2. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 VALVES

A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Section 230523.11 "Globe Valves for HVAC Piping," Section 230523.12 "Ball Valves for HVAC Piping," Section 230523.13 "Butterfly Valves for HVAC Piping," Section 230523.14 "Check Valves for HVAC Piping," and Section 230523.15 "Gate Valves for HVAC Piping."

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Section 230923.11 "Control Valves "Section 15901 "Control Valves."

C. Plastic Ball Valves:

1. Body: One-, two-, or three-piece CPVC or PVC to match piping.
2. Ball: Full-port CPVC or PVC to match piping.
3. Seats: PTFE.
4. Seals: EPDM.
5. End Connections: Socket, union, or flanged.
6. Handle Style: Tee shape.
7. CWP Rating: Equal to piping service.
8. Maximum Operating Temperature: Equal to piping service.
9. Comply with MSS SP-122.

D. Plastic Butterfly Valves:

1. Body: PVC or CPVC to match piping wafer type for installation between flanges.
2. Disc: EPDM-coated steel.
3. Seats: PTFE.
4. Handle Style: Locking lever.
5. CWP Rating: Equal to piping service.
6. Maximum Operating Temperature: Equal to piping service.

E. Plastic Check Valves:

1. Body: One-, two-, or three-piece PVC or CPVC to match piping.
2. Ends: Socket or flanged.
3. Seats: PTFE.
4. Check Style: Swing or ball type.
5. CWP Rating: Equal to piping service.
6. Maximum Operating Temperature: Equal to piping service.

F. Bronze, Calibrated-Orifice, Balancing Valves:

1. Body: Bronze, ball or plug type with calibrated orifice or venturi.
2. Ball: Brass or stainless steel.
3. Plug: Resin.
4. Seat: PTFE.
5. End Connections: Threaded or socket.
6. Pressure Gage Connections: Integral seals for portable differential pressure meter.
7. Handle Style: Lever, with memory stop to retain set position.
8. CWP Rating: Minimum 125 psig (860 kPa).
9. Maximum Operating Temperature: 250 deg F (121 deg C).

G. Diaphragm-Operated, Pressure-Reducing Valves: ASME labeled.

1. Body: Bronze or brass.
2. Disc: Glass and carbon-filled PTFE.
3. Seat: Brass.
4. Stem Seals: EPDM O-rings.
5. Diaphragm: EPT.
6. Low inlet-pressure check valve.
7. Inlet Strainer: Removable without system shutdown.
8. Valve Seat and Stem: Noncorrosive.
9. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

H. Diaphragm-Operated Safety Valves: ASME labeled.

1. Body: Bronze or brass.
2. Disc: Glass and carbon-filled PTFE.
3. Seat: Brass.
4. Stem Seals: EPDM O-rings.
5. Diaphragm: EPT.
6. Wetted, Internal Work Parts: Brass and rubber.
7. Inlet Strainer: Removable without system shutdown.
8. Valve Seat and Stem: Noncorrosive.
9. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

I. Automatic Flow-Control Valves:

1. Body: Brass or ferrous metal.
2. Piston and Spring Assembly: Stainless steel, tamper proof, self-cleaning, and removable.
3. Combination Assemblies: Include bonze or brass-alloy ball valve.
4. Identification Tag: Marked with zone identification, valve number, and flow rate.
5. Size: Same as pipe in which installed.
6. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
7. Minimum CWP Rating: 175 psig (1207 kPa).
8. Maximum Operating Temperature: 200 deg F (93 deg C).

2.3 AIR-CONTROL DEVICES

A. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2 (DN 15).
5. Discharge Connection: NPS 1/8 (DN 6).
6. CWP Rating: 150 psig (1035 kPa).
7. Maximum Operating Temperature: 225 deg F (107 deg C).

B. Expansion Tanks:

1. Tank: Welded steel, rated for 125-psig (860-kPa) working pressure and 375 deg F (191 deg C) maximum operating temperature, with taps in bottom of tank for tank fitting and taps in end of tank for gage glass. Tanks shall be factory tested after taps are fabricated and shall be labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Air-Control Tank Fitting: Cast-iron body, copper-plated tube, brass vent tube plug, and stainless-steel ball check, 100-gal. (379-L) unit only; sized for compression-tank diameter. Provide tank fittings for 125-psig (860-kPa) working pressure and 250 deg F (121 deg C) maximum operating temperature.
3. Tank Drain Fitting: Brass body, nonferrous internal parts; 125-psig (860-kPa) working pressure and 240 deg F (116 deg C) maximum operating temperature; constructed to admit air to compression tank, drain water, and close off system.
4. Gage Glass: Full height with dual manual shutoff valves, 3/4-inch- (20-mm-) diameter gage glass, and slotted-metal glass guard.

C. In-Line Air Separators:

1. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
2. Maximum Working Pressure: Up to 175 psig (1207 kPa).
3. Maximum Operating Temperature: Up to 300 deg F (149 deg C).

2.4 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.
3. Strainer Screen: Stainless-steel, 60-mesh strainer, or perforated stainless-steel basket.
4. CWP Rating: 125 psig (860 kPa).

B. Stainless-Steel Bellow, Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch (20-mm) misalignment.
4. CWP Rating: 150 psig (1035 kPa).
5. Maximum Operating Temperature: 250 deg F (121 deg C).

C. Expansion Fittings: Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping. "Section 15124 "Expansion Fittings and Loops for HVAC Piping."

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.

B. Install calibrated-orifice, balancing valves at each branch connection to return main.

C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.2 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.

C. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 (DN 50) and larger.

D. Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.

1. Install tank fittings that are shipped loose.
2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.

E. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system Project requirements.

END OF SECTION 232116

SECTION 233113

METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.
7. Seismic-restraint devices.

B. Related Sections:
1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 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/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 GENERAL

A. HVAC Duct shall be fabricated from galvanized steel in accordance with SMACNA requirements. Abrasive, corrosive, or hazardous materials shall be conveyed by systems described in Industrial Ventilation, latest edition, in harmony with the Fume Hood Section of these Design Standards. Nonmetallic duct shall not be used.

B. All seams of ducts shall be sealed with mastic or mastic plus tape or gasketing as appropriate to limit the air leakage to SMACNA requirements.

C. Flexible ductwork shall only be used at terminal units and shall not exceed eight feet. Hard turns, offsets, or kinks will not be allowed. Provide duct supports every three feet.

D. High pressure ductwork shall be galvanized steel spiral lockseam construction.

E. The high pressure duct and fittings shall be manufactured by the same firm.

F. High pressure ductwork shall be tested and total allowable leakage of the system shall not exceed SMACNA requirements.

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS – SEAL CLASS A

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."

2.3 SINGLE-WALL 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.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Lindab Inc.
      b. McGill AirFlow LLC.

c. SEMCO Incorporated.
d. Sheet Metal Connectors, Inc.
e. Spiral Manufacturing Co., Inc.

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 60 Inches (1524 mm) in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round 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."
1. Fabricate round ducts larger than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches (1830 mm) in width (major dimension) with butt-welded longitudinal seams.

D. 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."

2.4 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

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

1. Linx Industries (formerly Lindab).
2. McGill AirFlow LLC.
3. MKT Metal Manufacturing.
4. SEMCO LLC.
5. Sheet Metal Connectors, Inc.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.

1. 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."

a. Transverse Joints in Ducts Larger Than 60 Inches (1524 mm) in Diameter: Flanged.

2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round 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."

a. Fabricate round ducts larger than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.
b. Fabricate flat-oval ducts larger than 72 inches (1830 mm) in width (major dimension) with butt-welded longitudinal seams.

3. 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."

D. Inner Duct: Minimum 0.028-inch (0.7-mm) perforated galvanized sheet steel having 3/32-inch- (2.4-mm-) diameter perforations, with overall open area of 23 percent.

E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K) at 75 deg F (24 deg C) mean temperature.
2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
3. Coat insulation with antimicrobial coating.
4. Cover insulation with polyester film complying with UL 181, Class 1.

F. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.

1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F (0.034 W/m x K) at75 deg F (24 deg C) mean temperature.

2.5 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: G60 (Z180).
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

2.6 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. Two-Part Tape Sealing System:
1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 3 inches (76 mm).
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. 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).

C. 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 (2500 Pa), 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.
10. 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).
11. VOC: Maximum 395 g/L.
12. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive or negative.
13. Service: Indoor or outdoor.
14. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. 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).

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa) and shall be rated for10-inch wg (2500-Pa) 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.

2.7 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. 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.

2.8 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper B-Line, Inc.; a division of Cooper Industries.
2. Ductmate Industries, Inc.
3. Hilti Corp.
4. Kinetics Noise Control.
5. Loos & Co.; Cableware Division.
6. Mason Industries.
7. TOLCO; a brand of NIBCO INC.
8. Unistrut Corporation; Tyco International, Ltd..

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for

attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

D. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 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 round 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 (25 mm), 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 (38 mm).

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "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."

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

F. Seal ducts 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. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class A.
3. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class A.
4. Conditioned Space, Exhaust Ducts: Seal Class A
5. Conditioned Space, Return-Air Ducts: Seal Class A.

3.3 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 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 (500 Pa) and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): 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 (500 Pa) and Lower: Seal Class C.

10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 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 (100 mm) thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) 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 (Table 5-1M), "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 (610 mm) of each elbow and within 48 inches (1200 mm) 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 (5 m).

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.

3.5 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."
1. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.
2. Brace a change of direction longer than 12 feet (3.7 m).

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.

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

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

3.6 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems:

a. Ducts with a Pressure Class Higher Than 3-Inch wg (750 Pa): Test representative duct sections totaling no less than 100 percent of total installed duct area for each designated pressure class.
b. Supply Ducts with a Pressure Class of 2-Inch wg (500 Pa) or Higher: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
c. Return Ducts with a Pressure Class of 2-Inch wg (500 Pa) or Higher: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
d. Exhaust Ducts with a Pressure Class of 2-Inch wg (500 Pa) or Higher: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.

e. Outdoor Air Ducts with a Pressure Class of 2-Inch wg (500 Pa) or Higher: Test representative duct sections totaling no less than 100 percent of total installed duct area for each designated pressure class.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
6. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.8 DUCT CLEANING

A. Clean new and existing duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).

2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.9 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner or any ductwork noted on mechanical plans that require painting. Apply one coat of flat, latex paint over a compatible galvanized-steel primer.

3.10 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

3.12 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Underground Ducts: Concrete-encased, PVC-coated, galvanized sheet steel with thicker coating on duct exterior or pre-insulated high-density polyethylene.

B. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

   a. Pressure Class: Positive 1-inch wg (250 Pa).
   b. Minimum SMACNA Seal Class: C.
   c. SMACNA Leakage Class for Rectangular: 24.
   d. SMACNA Leakage Class for Round and Flat Oval: 24.

2. Ducts Connected to Constant-Volume Air-Handling Units:

   a. Pressure Class: Positive 2-inch wg (500 Pa).
   b. Minimum SMACNA Seal Class: B.
   c. SMACNA Leakage Class for Rectangular: 12.
   d. SMACNA Leakage Class for Round and Flat Oval: 12.

3. Ducts Connected to Variable-Air-Volume Air-Handling Units:

   a. Pressure Class: Positive 4-inch wg (1000 Pa).
   b. Minimum SMACNA Seal Class: A.
   c. SMACNA Leakage Class for Rectangular: 6.
   d. SMACNA Leakage Class for Round and Flat Oval: 3.

C. Return Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

   a. Pressure Class: Positive 1-inch wg (250 Pa).
   b. Minimum SMACNA Seal Class: C.
   c. SMACNA Leakage Class for Rectangular: 24.
   d. SMACNA Leakage Class for Round and Flat Oval: 24.

2. Ducts Connected to Air-Handling Units:

   a. Pressure Class: Positive or negative 3-inch wg (750 Pa).
   b. Minimum SMACNA Seal Class: A.
   c. SMACNA Leakage Class for Rectangular: 6.
   d. SMACNA Leakage Class for Round and Flat Oval: 6.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

   a. Pressure Class: Negative 3-inch wg (750 Pa).
   b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
   c. SMACNA Leakage Class for Rectangular: 12.
   d. SMACNA Leakage Class for Round and Flat Oval: 6.

2. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.

a. Exposed to View: Type 304, stainless-steel sheet, No. 4 finish.
b. Concealed: Type 304, welded black iron.
c. Welded seams and joints.
d. Pressure Class: Positive or negative 2-inch wg (500 Pa).
e. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
f. SMACNA Leakage Class: 3.

3. Ducts Connected to Dishwasher Hoods:

a. Type 304, stainless-steel sheet.
b. Exposed to View: No. 4 finish.
c. Concealed: No. 2D finish.
d. Welded seams and flanged joints with watertight EPDM gaskets.
e. Pressure Class: Positive or negative 2-inch wg (500 Pa).
f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
g. SMACNA Leakage Class: 3.

4. Ducts Connected to Fans Exhausting Laboratory and Process (ASHRAE 62.1, Class 3 and 4) Air:

a. Type 316, stainless-steel sheet.

1) Exposed to View: No. 4 finish.
2) Concealed: No. 2B finish.

b. PVC-coated, galvanized sheet steel with thicker coating on duct interior.
c. Pressure Class: Positive or negative 4-inch wg (1000 Pa).
d. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
e. SMACNA Leakage Class: 3.

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

a. Pressure Class: Positive 1-inch wg (250 Pa).
b. Minimum SMACNA Seal Class: C.
c. SMACNA Leakage Class for Rectangular: 24.
d. SMACNA Leakage Class for Round and Flat Oval: 24.

2. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 3-inch wg (750 Pa).
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 6.

F. Intermediate Reinforcement:
1. Galvanized-Steel Ducts: Galvanized steel.

G. Liner:
1. Supply Air Ducts: Fibrous glass, Type I, 1 inch (25 mm) thick.

H. Double-Wall Duct Interstitial Insulation:

1. Supply Air Ducts: 1 inch (25 mm) thick.
2. Acoustical Performance:
   a. NRC: 1.09 according to ASTM C 423.
   b. STC: 40 according to ASTM E 90.

I. 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 (5 m/s) 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 (5 to 7.6 m/s):
      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 (7.6 m/s) 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.
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 (5 m/s) or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
      2) Velocity 1000 to 1500 fpm (5 to 7.6 m/s): 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
      3) Velocity 1500 fpm (7.6 m/s) 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 (305 mm) and Smaller in Diameter: Stamped or pleated.
   c. Round Elbows, 14 Inches (356 mm) and Larger in Diameter.

J. 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.

2. Round and Flat Oval: 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 (5 m/s) or Lower: 90-degree tap.
   b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.
   c. Velocity 1500 fpm (7.6 m/s) or Higher: 45-degree lateral.

END OF SECTION 233113

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SECTION 233300

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Manual volume dampers.
2. Control dampers.
3. Turning vanes.
4. Remote damper operators.
5. Duct-mounted access doors.
6. Flexible connectors.
7. Flexible ducts.
8. Duct accessory hardware.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 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.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
1. Galvanized Coating Designation: G60 (Z180).
2. Exposed-Surface Finish: Mill phosphatized.

B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2.

C. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M), 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 (ASTM B 221M), 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 (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.3 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Air Balance Inc.; a division of Mestek, Inc.
   b. American Warming and Ventilating; a division of Mestek, Inc.
   c. Flexmaster U.S.A., Inc.
   d. McGill AirFlow LLC.
   e. Nailor Industries Inc.
   f. Pottorff.
   g. Ruskin Company.
   h. Trox USA Inc.
   i. Vent Products Company, Inc.
2. Standard leakage rating
3. Suitable for horizontal or vertical applications.
4. Frames:
   a. Frame: Hat-shaped, 0.094-inch- (2.4-mm-) thick, galvanized sheet steel.
   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. Galvanized-steel, 0.064 inch (1.62 mm) thick.
6. Blade Axles: Galvanized steel.
7. Bearings:
   a. Oil-impregnated bronze.
   b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) 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.

2.4 CONTROL DAMPERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
1. American Warming and Ventilating; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Greenheck Fan Corporation.
5. Lloyd Industries, Inc.
6. McGill AirFlow LLC.

7. Metal Form Manufacturing, Inc.
8. Nailor Industries Inc.
9. NCA Manufacturing, Inc.
10. Pottorff.
11. Ruskin Company.
12. Vent Products Company, Inc.
13. Young Regulator Company.

B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Frames:
1. Hat shaped.
2. 0.094-inch- (2.4-mm-) thick, galvanized sheet steel.
3. Mitered and welded corners.

D. Blades:
1. Multiple blade with maximum blade width of 6 inches (152 mm).
2. Opposed-blade design.
3. Galvanized-steel.
4. 0.064 inch (1.62 mm) thick single skin.
5. Blade Edging: Closed-cell neoprene.
6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

E. Blade Axles: 1/2-inch- (13-mm-) diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
1. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).

F. Bearings:
1. Oil-impregnated bronze.
2. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
3. Thrust bearings at each end of every blade.

2.5 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Elgen Manufacturing.
4. METALAIRE, Inc.
5. SEMCO Incorporated.
6. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. 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.

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: Single wall.

E. Vane Construction: Single wall for ducts up to 48 inches (1200 mm) wide and double wall for larger dimensions.

2.6 REMOTE DAMPER OPERATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Pottorff.
2. Ventfabrics, Inc.
3. Young Regulator Company..

B. Description: Cable system designed for remote manual damper adjustment.

C. Tubing: Brass.

D. Cable: Stainless steel.

E. Wall-Box Mounting: Recessed.

F. Wall-Box Cover-Plate Material: Steel.

2.7 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Warming and Ventilating; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Ductmate Industries, Inc.
4. Elgen Manufacturing.
5. Flexmaster U.S.A., Inc.
6. Greenheck Fan Corporation.
7. McGill AirFlow LLC.
8. Nailor Industries Inc.
9. Pottorff.
10. Ventfabrics, Inc.
11. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2 (7-2M), "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 (25-by-25-mm)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 (300 mm) Square: No hinges and two sash locks.
   b. Access Doors up to 18 Inches (460 mm) Square: Continuous and two sash locks.
   c. Access Doors up to 24 by 48 Inches (600 by 1200 mm): Continuous and two compression latches with outside and inside handles.
   d. Access Doors Larger Than 24 by 48 Inches (600 by 1200 mm): Continuous and two compression latches with outside and inside handles.

2.8 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ductmate Industries, Inc.
   2. Duro Dyne Inc.
   3. Elgen Manufacturing.
   4. Ventfabrics, Inc.
   5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches (89 mm) wide attached to two strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized sheet steel or 0.032-inch- (0.8-mm-) thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
   1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
   2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
   3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

2.9 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Flexmaster U.S.A., Inc.
   2. McGill AirFlow LLC.
   3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
   1. Pressure Rating: 4-inch wg (1000 Pa) positive and 0.5-inch wg (125 Pa) negative.
   2. Maximum Air Velocity: 4000 fpm (20 m/s).
   3. Temperature Range: Minus 20 to plus 175 deg F (Minus 29 to plus 79 deg C).
   4. Insulation R-Value: Comply with ASHRAE/IESNA 90.1.

C. Flexible Duct Connectors:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches (75 through 460 mm), to suit duct size.
2. Non-Clamp Connectors: Adhesive plus sheet metal screws.

PART 3 - EXECUTION

3.1 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 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.
1. Install steel volume dampers in steel ducts.

D. Set dampers to fully open position before testing, adjusting, and balancing.

E. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

F. Install access doors with swing against duct static pressure.

G. Access Door Sizes:
1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).
2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
5. Body Access: 25 by 14 inches (635 by 355 mm).
6. Body plus Ladder Access: 25 by 17 inches (635 by 430 mm).

H. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

I. Install flexible connectors to connect ducts to equipment.

J. For fans developing static pressures of 5-inch wg (1250 Pa) and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

K. Connect terminal units to supply ducts with maximum 12-inch (300-mm) lengths of flexible duct. Do not use flexible ducts to change directions.

L. Connect diffusers or light troffer boots to ducts in-directly with maximum 36-inch (900-mm) lengths of flexible duct clamped or strapped in place. Do not use flexible ducts to change directions.

M. Connect flexible ducts to metal ducts with liquid adhesive plus clamp-type draw bands.

N. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch (6-mm) movement during start and stop of fans.

3.2 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. Inspect turning vanes for proper and secure installation.
   4. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 233600

AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Shutoff, single-duct air terminal units.

1.2 ACTION SUBMITTALS

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

B. LEED Submittals:

1. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."

C. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work.

D. Delegated-Design Submittal:

1. Materials, fabrication, assembly, and spacing of hangers and supports.
2. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7.

2.2 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

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

1. Krueger.
2. Price Industries.
3. Titus.
4. Trane.

B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.

C. Casing: 0.032-inch (0.8-mm) aluminum, single wall.

1. Casing Lining: Adhesive attached, 1/2-inch thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.

    a. Cover liner with nonporous foil.

2. Casing Lining: Adhesive attached, 1-inch- (25-mm-) thick, polyurethane foam insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
3. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
4. Air Outlet: S-slip and drive connections, size matching inlet size.
5. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.

1. Maximum Damper Leakage: ARI 880 rated, percent of nominal airflow at 6-inch wg (1500-Pa) inlet static pressure.
2. Damper Position: Normally closed.

E. Attenuator Section: 0.032-inch (0.8-mm) aluminum sheet.

1. Lining: Adhesive attached, 1-inch- (25-mm-) thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
   a. Cover liner with nonporous foil and perforated metal.

2. Lining: Adhesive attached, 3/4-inch- (19-mm-) thick, polyurethane foam insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

F. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm), and rated for a minimum working pressure of 200 psig (1380 kPa) and a maximum entering-water temperature of 220 deg F (104 deg C). Include manual air vent and drain valve.

G. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.

1. Access door interlocked disconnect switch.
2. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable.)
3. Nickel chrome 80/20 heating elements.
4. Airflow switch for proof of airflow.
5. Fan interlock contacts.
6. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
7. Mercury contactors.
8. Magnetic contactor for each step of control (for three-phase coils).

H. Electric Controls: Damper actuator and thermostat.

1. Damper Actuator: 24 V, powered closed, powered open.
2. Thermostat: Wall-mounted electronic type with clock display, temperature display in Fahrenheit and Celsius, and space temperature set point.

I. Electronic Controls: Bidirectional damper operator and microprocessor-based thermostat with integral airflow transducer and room sensor. Control devices shall be compatible with temperature controls and shall have the following features:

1. Damper Actuator: 24 V, powered closed, powered open.

2. Velocity Controller: Factory calibrated and field adjustable to minimum and maximum air volumes; shall maintain constant airflow dictated by thermostat within 5 percent of set point while compensating for inlet static-pressure variations up to 4-inch wg (1000 Pa); and shall have a multipoint velocity sensor at air inlet.
3. Thermostat: Wall-mounted electronic type with temperature set-point display in Fahrenheit and Celsius.

J. Direct Digital Controls: Single-package unitary controller and actuator specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."

K. Direct Digital Controls: Bidirectional damper operators and microprocessor-based controller and room sensor. Control devices shall be compatible with temperature controls specified in Section 230923 "Direct Digital Control (DDC) System for HVAC" and shall have the following features:

1. Damper Actuator: 24 V, powered closed, powered open.
2. Terminal Unit Controller: Pressure-independent, variable-air-volume controller with electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes, and having the following features:

    a. Occupied and unoccupied operating mode.
    b. Remote reset of airflow or temperature set points.
    c. Adjusting and monitoring with portable terminal.
    d. Communication with temperature-control system specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."

3. Room Sensor: Wall mounted, with temperature set-point adjustment and access for connection of portable operator terminal.

2.3 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. Steel Cables: Galvanized steel complying with ASTM A 603.

D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

2.4 SEISMIC-RESTRAINT DEVICES

A. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

B. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

C. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; with an automatic-locking and clamping device or double-cable clips.

D. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

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

2.5 SOURCE QUALITY CONTROL

A. Factory Tests: Test assembled air terminal units according to ARI 880.

1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

C. Install wall-mounted thermostats.

3.2 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 and for slabs more than 4 inches (100 mm) thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches (100 mm) thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hangers Exposed to View: Threaded rod and angle or channel supports.

D. 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.

3.3 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install hangers and braces designed to support the air terminal units and to restrain against seismic forces required by applicable building codes. Comply with ASCE/SEI 7.

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on air terminal units that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.

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

G. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items before drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Install heavy-duty sleeve anchors 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 applications and stainless-steel anchors for applications exposed to weather.

3.4 CONNECTIONS

A. Install piping adjacent to air terminal unit to allow service and maintenance.

B. Hot-Water Piping: In addition to requirements in Section 232113 "Hydronic Piping" and Section 232116 "Hydronic Piping Specialties, "Section 15179 "Hydronic Piping Specialties," connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.

C. Connect ducts to air terminal units according to

D. Make connections to air terminal units with flexible connectors complying with requirements in Section 233300 "Air Duct Accessories."

3.5 IDENTIFICATION

A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Air terminal unit will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.7 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
3. Verify that controls and control enclosure are accessible.
4. Verify that control connections are complete.
5. Verify that nameplate and identification tag are visible.
6. Verify that controls respond to inputs as specified.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION 233600

SECTION 233713

DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Round ceiling diffusers.
2. Rectangular and square ceiling diffusers.
3. Perforated diffusers.
4. Louver face diffusers.
5. Linear bar diffusers.
6. Linear slot diffusers.
7. Adjustable bar grilles.
8. Fixed face grilles.
9. Linear bar grilles.

B. Related Sections:

1. Section 089116 "Operable Wall Louvers" and Section 089119 "Fixed Louvers" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Rectangular and Square Ceiling Diffusers:

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

    a. Anemostat Products; a Mestek company.
    b. Carnes Company.
    c. Hart & Cooley Inc.
    d. Krueger.
    e. Nailor Industries Inc.
    f. Price Industries.
    g. Shoemaker Mfg. Co.
    h. Titus.
    i. Tuttle & Bailey.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Aluminum.
4. Finish: Baked enamel, color selected by Architect.
5. Face Size: See drawings
6. Face Style: See drawings
7. Mounting: See drawings
8. Pattern: See drawings
9. Dampers: Radial opposed blade.
10. Accessories:

    a. Equalizing grid.
    b. Plaster ring.
    c. Safety chain.
    d. Wire guard.
    e. Sectorizing baffles.
    f. Operating rod extension.

B. Perforated Diffuser:

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

    a. Anemostat Products; a Mestek company.
    b. Carnes Company.
    c. Hart & Cooley Inc.
    d. Krueger.
    e. Nailor Industries Inc.
    f. Price Industries.
    g. Shoemaker Mfg. Co.
    h. Titus.
    i. Tuttle & Bailey.

2.

3. Devices shall be specifically designed for variable-air-volume flows.
4. Material: Steel backpan and pattern controllers, with aluminum face.
5. Finish: Baked enamel, color selected by Architect.
6. Face Size: See drawings
7. Duct Inlet: See drawings
8. Face Style: Flush.

9. Mounting: See drawings.
10. Pattern Controller: None.
11. Dampers: None
12. Accessories:

    a. Equalizing grid.
    b. Plaster ring.
    c. Safety chain.
    d. Wire guard.
    e. Sectorizing baffles.
    f. Operating rod extension.

C. Louver Face Diffuser:

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

    a. Anemostat Products; a Mestek company.
    b. Carnes Company.
    c. Hart & Cooley Inc.
    d. Krueger.
    e. Nailor Industries Inc.
    f. Price Industries.
    g. Shoemaker Mfg. Co.
    h. Titus.
    i. Tuttle & Bailey.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Aluminum.
4. Finish: Baked enamel, color selected by Architect.
5. Face Size: See drawings
6. Mounting: See Drawings
7. Pattern: See Drawings
8. Dampers: Radial opposed blade.
9. Accessories:

    a. Square to round neck adaptor.
    b. Adjustable pattern vanes.
    c. Throw reducing vanes.
    d. Equalizing grid.
    e. Plaster ring.
    f. Safety chain.
    g. Wire guard.
    h. Sectorizing baffles.
    i. Operating rod extension.

2.2 CEILING LINEAR SLOT OUTLETS

A. Linear Bar Diffuser:

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

    a. Anemostat Products; a Mestek company.

b. Carnes Company.
c. Hart & Cooley Inc.
d. Krueger.
e. Nailor Industries Inc.
f. Price Industries.
g. Shoemaker Mfg. Co.
h. Titus.
i. Tuttle & Bailey.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Aluminum.
4. Finish: Baked enamel, color selected by Architect.
5. Narrow Core Spacing Arrangement: 1/8-inch- (3-mm-) thick blades spaced 1/4 inch (6 mm) apart, 15-degree deflection.
6. Frame: 1 inch (25 mm) wide.

B. Linear Slot Diffuser:

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

a. Anemostat Products; a Mestek company.
b. Carnes Company.
c. Hart & Cooley Inc.
d. Krueger.
e. Nailor Industries Inc.
f. Price Industries.
g. Shoemaker Mfg. Co.
h. Titus.
i. Tuttle & Bailey.

2. Devices shall be specifically designed for variable-air-volume flows.
3. Material - Shell: Aluminum,.
4. Material - Pattern Controller and Tees: Aluminum.
5. Finish - Face and Shell: Baked enamel, black.
6. Finish - Pattern Controller: Baked enamel, black.
7. Finish - Tees: Baked enamel, color selected by Architect.
8. Slot Width: See drawings.
9. Number of Slots: See drawings.
10. Length: See Drawings.
11. Accessories: Engineered plenum.

2.3 REGISTERS AND GRILLES

A. Adjustable Bar Register:

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

a. Anemostat Products; a Mestek company.
b. Carnes Company.
c. Hart & Cooley Inc.
d. Krueger.
e. Nailor Industries Inc.

f. Price Industries.
g. Shoemaker Mfg. Co.
h. Titus.
i. Tuttle & Bailey.

2. Material: Aluminum.
3. Finish: Baked enamel, color selected by Architect.
4. Face Blade Arrangement: Horizontal spaced 1/2 inch (13 mm) apart.
5. Core Construction: Integral.

2.4 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as 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 diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

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	Facility Services Subgroup	
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SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout.
5. Common electrical installation requirements.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For sleeve seals.

1.5 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:
1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Sleeves for Rectangular Openings: Galvanized sheet steel.
   1. Minimum Metal Thickness:
      a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
      b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

C. Fire-Rated Assemblies for Low Voltage Penetrations (Communications, etc.): Engineered prefabricated fire stop system. The acceptable manufacturers of firestop systems are:
   1. STI Firestop (EZ-Path)

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Metraflex Co.
      d. Pipeline Seal and Insulator, Inc.
   2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
   3. Pressure Plates: Carbon steel. Include two for each sealing element.
   4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

F. Mock Ups: In each of the rooms listed below, coordinate with the architect and owner to provide one mock up room prior to further work in any identical or similar room for owner review and approval. In rooms or parts of rooms with stud walls, provide in the frame of each room box locations only, without conduits, identified with colored tape as to purpose (receptacle, tele/data, switch, etc.). In rooms with masonry or concrete walls, provide either a layout chalked on the floor of the room or, alternately, a hung sheet of paper with the locations of devices color coded:
   1. Procedure Room
   2. Prep Room
   3. Recovery Room
   4. Exam Room
   5. Medication Room
   6. Consult Room
   7. Workroom

G. Storage: Store all equipment and components in locked, inaccessible spaces during construction. The contractor shall be responsible for the replacement of any lost or damaged equipment.

H. Workmanship: All work shall be performed by qualified individuals and shall meet the highest standard of workmanship. Any work found by the owner, architect, or engineer to be less than the required standard of workmanship shall be replaced at the contractor's expense.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL AND LOW VOLTAGE PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies for Electrical Penetrations: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Fire-Rated Assemblies for Low Voltage Penetrations (Communications, etc.): Install listed firestop system from one of the acceptable manufacturer products listed below during construction of floor or wall at each point where communications cabling, cable tray, conduit, sleeves, etc., penetrate a fire-rated assembly. The acceptable manufacturers of firestop systems are:
   1. STI EZ-Path

F. Cut sleeves to length for mounting flush with both surfaces of walls.

G. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

H. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry
   1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants.".

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials where engineered prefabricated fire stop system is not installed per specifications. Comply with requirements in Division 07 Section "Penetration Firestopping."

L. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

N. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.5 COMMISSIONING

A. Refer to the commissioning specifications for additional scope of work required for commissioning of various project components included in Divisions 26, 27, and 28. The requirements and scope of work included in the commissioning specifications is hereby incorporated by reference.

END OF SECTION 260500

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:
1. Section 26 05 33 “Raceways and Boxes for Electrical Systems”
2. Section 26 09 23 “Lighting Control Devices”
3. Section 26 09 36 “Standalone Modular Preset Dimming Controls”
4. Section 26 09 43 “Relay-Based Lighting Controls”
5. Section 27 41 33 “Master Antenna Television System”
6. Section 27 51 17 “Networked Public Address and Paging System”
7. Section 27 51 19 “Sound Masking Systems”
8. Section 28 13 00 “Access Control”
9. Section 28 31 11 “Digital, Addressable Fire-Alarm System”
10. Section 27 00 00 "Intermountain Healthcare Networked Structured Cable & Standards" for cabling used for voice and data circuits.

1.3 DEFINITIONS

A. Outlet Box: Electrical box used to support utilization equipment such as a receptacle or light fixture.

B. Pull Box: Electrical box through which branch circuit or feeder conductors are run but are not spliced.

C. Junction Box: Electrical box used for splicing branch circuit or feeder conductors.

D. Multiwire Branch Circuit: A branch circuit as defined by the National Electrical Code that shares a grounded conductor between two of more phase conductors.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SINGLE CONDUCTORS

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. Alpha Wire Company.
   2. Belden Inc.
   3. Cerro Wire LLC.
   4. Encore Wire Corporation.
   5. General Cable; General Cable Corporation.
   6. Southwire Company.
   7. Thomas & Betts Corporation; A Member of the ABB Group.

B. Aluminum and Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN/THWN-2, Type XHHW-2 and Type SO.

2.2 MULTI-CONDUCTOR CABLES

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. Southwire Company.
   2. AFC Cable Systems.

B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN/THWN-2, Type XHHW-2 and Type SO.

D. Multi-conductor Cable, Type AC-HCF:
   1. Armor: Galvanized Interlocking Steel Strip (green striped or solid green).
   2. Conductors: Solid Copper
   3. Conductor Insulation: THHN-2 with individual moisture resistant, fire retardant paper wrap on each individual conductor.
   4. Grounding: 16 AWG integral bond wire and insulated green copper grounding conductor.
   5. Neutral (Grounded) Conductor: White for 120Y/208 volt systems and Grey 480Y/277 volt systems.
   6. Maximum Voltage Rating: 600 volts.
   7. References and Ratings:
      a. UL 4, 83, 1479, 1581, 2556, File Reference E7330
      b. NEC 250.118(8), 300.22(C), 392, 320, 517.13, 518, 645
      c. Federal Specification A-A–59544 (formerly J-C–30B)
      d. UL Classified 1, 2, and 3-hour through (Fire) penetration product, R–14141
      e. Environmental Air-Handling Space Installation per NEC 300.22(C)

E. Other Multi-conductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for Type SO with ground wire.

2.3 CONNECTORS AND SPLICES

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. 3M.
2. AFC Cable Systems; a part of Atkore International.
3. Hubbell Power Systems, Inc.
4. Ideal Industries, Inc.
5. ILSCO.
6. O-Z/Gedney; a brand of Emerson Industrial Automation.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.4 CORD REELS

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. APC Group; Kitchen Leash

B. Case (housing):
1. Dimensions: 9” x 12” x 3’
2. Material: Molded Polypropylene 3.175 mm thickness
3. 94v-2 flammability rating

C. Power Cord
1. Conductors: 14/3 AWG copper type SJOW
2. Length: 10 feet
3. Rating: 200 degrees F

D. Receptacle/Plug
1. Rated: 125vac/20 amp
2. Receptacle: NEMA 5-15P
3. Plug: Dual Duplex rated 20 amp

E. Mounting Bracket: Designed for installation on the ceiling type where the cord reel will be installed.

2.5 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 NFPA 70.

2.6 FIRE-ALARM WIRE AND CABLE

A. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

B. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer.

1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.

C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.

1. Low-Voltage Circuits: No. 14 AWG, minimum, in pathway.
2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper for feeders smaller than No. 4 AWG; for feeders No. 4 AWG and larger provide copper feeders unless aluminum is specifically indicated on the one-line diagrams. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger. Aluminum conductors may not be installed for circuiting to imaging and mechanical equipment.

B. Branch Circuits: Copper. Solid or stranded for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Refer to Section 26 05 33 “Raceways and Boxes for Electrical Systems” for raceway types and applications.

B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

D. Feeders below Slabs-On-Grade, and Underground: Type THWN-2, single conductors in raceway.

E. Multiwire Circuits: may not be used for branch circuit wiring. All 120 volt and 277 volt circuits shall be provided with a dedicated grounded conductor (neutral) for each phase conductor. Up to three of these circuits may be installed in a single conduit but not more than one conductor of each phase may be installed in a single conduit.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.

1. Armored cable, Type AC-HCF may be installed for normal and equipment system single branch circuits concealed in walls, and partitions in lengths between outlet boxes 30’ or less and not as homeruns or wiring between pullboxes or junction boxes.

2. Armored cable, Type AC-HCF may be installed between the first outlet box concealed in a wall or partition and a junction box above an accessible ceiling immediately above the location where the cable exits the wall or partition framing.

G. Branch Circuits below Slabs-on-Grade and Underground: Type THHN/THWN-2, single conductors in raceway. Installation of raceways within any concrete slab or composite concrete and steel deck is prohibited. NEC 517.13 (A) requires that all branch circuits serving patient care areas are provided with an effective ground-fault current path by installation in a metal raceway system, or a cable having a metallic armor or sheath assembly that qualifies as an equipment grounding conductor. Metallic raceways are not a specified raceway for branch circuits installed below slabs-on-grade. To assure compliance with the NEC requirement, both initially and when remodels occur in the future, the installation of branch circuit wiring under slabs-on-grade is limited to circuits supplying only the following rooms and area types without extension beyond the room or area to a room or area not listed here:
1. Mechanical Spaces.
2. Electrical Rooms.
3. Food Service.

H. Branch circuit wiring may also be installed under slabs-on-grade to supply power for the following:
1. Systems Furniture.
2. Floor Boxes.
3. Direct wired equipment that is not located against a wall.

I. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain-relief device at terminations to suit application.

J. Isolated Power System Conductors: #10 AWG, Type XHHW-2 stranded with cross-linked PE insulation and a dielectric constant of 3.5 or less, installed in EMT conduit. To limit leakage-current the branch circuit conductors must be reduced to the shortest overall length possible. Install conduits for Isolated Power System branch circuits in the most direct path between the panel and the outlet box, which is not necessarily parallel and perpendicular to the structure and framing, to reduce conductor length. Install only one circuit in per conduit. Do not use pulling compounds when installing the branch circuit conductors of Isolated Power Systems.

3.3 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. Do not use pulling compounds or lubricant for installation of branch circuit conductors for Isolated Power Systems.

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."

3.4 CORD REELS

A. Coordinate location of cord reels to align with kitchen equipment supplied by the cord reel.

B. Fasten brackets to structure using minimum 3/8” threaded rod and to rigidly support the cord real. Minimum of 2 rods per bracket with addition if required to provide a rigid support.

C. Adjust cord stopper as coordinated with owner.

3.5 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.
1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

D. Comply with requirements in Section 283111 "Digital, Addressable Fire-Alarm System" for connecting, terminating, and identifying wires and cables.

3.6 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 panel and circuit number and identify as spare conductor.

3.7 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."

3.8 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 07 84 13 "Penetration Firestopping."

3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test feeder conductors and conductors feeding the following critical equipment and services for compliance with requirements.
   a. Imaging Equipment
2. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
   a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
   b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

B. Test and Inspection Reports: Prepare a written report to record the following:
   1. Procedures used.
   2. Results that comply with requirements.
   3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

C. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION

SECTION 260523

CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Application
1. This specification section covers provision and installation of control and low-voltage electrical power cables including cables associated with building automatic systems (BAS), low voltage lighting controls, mechanical systems control cables, and all similar control and low-voltage cabling utilized for control of devices and equipment not associated with data and telecommunications systems which are covered by Division 27 and fire alarm, security, and specialty systems which are covered by Division 28. However, comply with the requirements of Division 27 where related to non-data and telecommunications cabling.

B. Section Includes:
1. Category 5e balanced twisted pair cable.
2. Category 6 balanced twisted pair cable.
3. Category 6a balanced twisted pair cable.
4. RS-485 cable.
5. Control cable.
6. Control-circuit conductors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Source quality-control reports.

B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 CABLING

A. Provide style and type of cabling as specified herein or as otherwise directed by the manufacturer of the equipment bring controlled or controlling devices and/or relevant specification section for the respective equipment.

2.2 PERFORMANCE 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. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262, by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.

1. Flame Travel Distance: 60 inch (1520 mm) or less.
2. Peak Optical Smoke Density: 0.5 or less.
3. Average Optical Smoke Density: 0.15 or less.

C. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.

D. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.

2.3 BACKBOARDS

A. Description: Plywood, fire-retardant treated, 3/4 by 48 by 96 inch (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels in Section 061000 "Rough Carpentry."

B. Painting: Paint plywood on all sides and edges with flat white latex paint. Comply with requirements in Section 099123 "Interior Painting."

2.4 CATEGORY 5e BALANCED TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 5e cable at frequencies up to 100 MHz.

B. Standard: Comply with ICEA S-90-661, NEMA WC 63.1, and TIA-568-C.2 for Category 5e cables.

C. Conductors: 100 ohm, No. 24 AWG solid copper.

D. Shielding/Screening: Unshielded twisted pairs (UTP) unless owner specific requirements require screened twisted pairs (F/UTP).

E. Cable Rating: Plenum.

F. Jacket: White thermoplastic unless otherwise specified by relevant specification section.

2.5 CATEGORY 6 BALANCED TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250 MHz.

B. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.

C. Conductors: 100 ohm, No. 23 AWG solid copper.

D. Shielding/Screening: Unshielded twisted pairs (UTP) unless owner specific requirements require screened twisted pairs (F/UTP).

E. Cable Rating: Plenum.

F. Jacket: White thermoplastic unless otherwise specified by relevant specification section.

2.6 CATEGORY 6a BALANCED TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 6a cable at frequencies up to 500 MHz.

B. Standard: Comply with TIA-568-C.2 for Category 6a cables.

C. Conductors: 100 ohm, No. 23 AWG solid copper.

D. Shielding/Screening: Unshielded twisted pairs (UTP) unless owner specific requirements require screened twisted pairs (F/UTP).

E. Cable Rating: Plenum.

F. Jacket: White thermoplastic unless otherwise specified by relevant specification section.

2.7 BALANCED TWISTED PAIR CABLE HARDWARE

A. Description: Hardware designed to connect, splice, and terminate balanced twisted pair copper communications cable.

B. General Requirements for Balanced Twisted Pair Cable Hardware:

1. Comply with the performance requirements of selected cable.
2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
3. Cables must be terminated with connecting hardware of same category or higher.
4. Provide balanced twisted pair cable hardware suitable for the application and consistent with recommendations of manufacturer of respective device and/or equipment controlled by control wiring.

2.8 RS-232 CABLE

A. PVC-Jacketed, TIA 232-F:

1. Three or nine, No. 22 AWG, stranded (7x30) tinned copper conductors, as required by specific control application.
2. Polypropylene insulation.
3. Aluminum foil-polyester tape shield with 100 percent shield coverage.
4. PVC jacket.
5. Conductors are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
6. NFPA 70 Type: Type CM.
7. Flame Resistance: Comply with UL 1581.

B. Plenum-Type, TIA 232-F:

1. Three or nine, No. 22 AWG, stranded (7x30) tinned copper conductors, as required by specific control application.
2. PE insulation.
3. Aluminum foil-polyester tape shield with 100 percent shield coverage.

4. Fluorinated ethylene propylene jacket.
5. Conductors are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
6. Flame Resistance: Comply with NFPA 262.

2.9 RS-485 CABLE

A. Standard Cable: NFPA 70, Type CMG.

1. Paired, one pair or two pairs, twisted, No. 22 AWG, stranded (7x30) tinned-copper conductors, as required by specific control application.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1685.

B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, one pair or two pairs, twisted, No. 22 AWG, stranded (7x30) tinned-copper conductors, as required by specific control application.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. Flame Resistance: NFPA 262.

2.10 CONTROL CABLE

A. Paired Cable: NFPA 70, Type CMG.

1. One or multi-pair, twisted, No. 18 AWG, stranded (19x30) tinned-copper conductors, as required by specific control application.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1685.

B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

1. One or multi-pair, twisted, No. 18 AWG, stranded (19x30) tinned-copper conductors, as required by specific control application.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

2.11 CONTROL-CIRCUIT CONDUCTORS

A. Class 1 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.

B. Class 2 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway, Type XHHW-2, complying with UL 44 in raceway, power-limited cable, concealed in building finishes, or power-limited tray cable, in cable tray, based on application.

C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway, Type XHHW-2, complying with UL 44 in raceway, power-limited cable, concealed in building finishes, or power-limited tray cable, in cable tray, based on application.

2.12 SOURCE QUALITY CONTROL

A. Factory test twisted pair cables according to TIA-568-C.2.

B. Cable will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF RACEWAYS AND BOXES

A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or modified in this Section.

1. Outlet boxes must be no smaller than 2 inch (50 mm) wide, 3 inch (75 mm) high, and 2-1/2 inch (64 mm) deep.
2. Flexible metal conduit must not be used.

B. Comply with TIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.

C. Install manufactured conduit sweeps and long-radius elbows if possible.

D. Raceway Installation in Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.
2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard if entering the room from overhead.
4. Extend conduits 3 inch (75 mm) above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

E. Backboards: Install backboards with 96 inch (2440 mm) dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.2 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:
   1. Terminate all conductors; cable must not contain unterminated elements. Make terminations only at outlets, terminals, and cross-connect and patch panels.
   2. Category 5e, 6, and 6A cables may not be spliced and must be continuous from terminal to terminal. Do not splice cable between termination, tap, or junction points.
   3. Cables serving a common system may be grouped in a common raceway. Install control wiring and cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
   4. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii.
   5. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
   6. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
   7. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
   8. Provide strain relief.
   9. Keep runs short. Allow extra length for connecting to terminals. Do not bend cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.

C. Installation and Support:
   1. Support: Secure and support all control cables, including cables associated with building automatic systems (BAS), low voltage lighting controls, mechanical systems control cables, and all similar control and low-voltage cabling utilized for control of devices and equipment not associated with data and telecommunications systems which are covered by Division 27 and fire alarm, security, and specialty systems which are covered by Division 28, at intervals not exceeding 30 inch (760 mm) and not more than 6 inch (150 mm) from cabinets, boxes, equipment, fittings, outlets, racks, frames, and terminals. Provide supports (cable trays, j-hooks, raceway, etc.) as required; do not support control cabling from ceiling, conduits, ducts, equipment, etc.
   2. Cabling not supported per the specification which is draped over ceilings, conduits, ducts, equipment, etc., will be rejected and require reinstallation in compliance with the support provisions of this specification.

D. Balanced Twisted Pair Cable Installation:

   1. Comply with TIA-568-C.2.
   2. Install termination hardware as specified in Section 271513 "Communications Copper Horizontal Cabling" unless otherwise indicated.
   3. Do not untwist balanced twisted pair cables more than 1/2 inch (12 mm) at the point of termination to maintain cable geometry.

E. Installation of Control-Circuit Conductors:

   1. Install wiring in raceways.
   2. Use insulated spade lugs for wire and cable connection to screw terminals.
   3. Comply with requirements specified in Section 260533 "Raceways and Boxes for Electrical Systems."

F. Separation from EMI Sources:

   1. Comply with BICSI TDMM and TIA-569-D recommendations for separating unshielded copper voice and data communications cable from potential EMI sources including electrical power lines and equipment.

2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment must be as follows:

    a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 5 inch (127 mm).
    b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 12 inch (305 mm).
    c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 24 inch (600 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment must be as follows:

    a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 2-1/2 inch (64 mm).
    b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 6 inch (150 mm).
    c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 12 inch (305 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures must be as follows:

    a. Electrical Equipment or Circuit Rating Less Than 2 kVA: No requirement.
    b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 3 inch (75 mm).
    c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 6 inch (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 48 inch (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inch (127 mm).

3.3 REMOVAL OF CONDUCTORS AND CABLES

A. Remove abandoned conductors and cables. Abandoned conductors and cables are those installed that are not terminated at equipment and are not identified with a tag for future use.

3.4 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits; No 14 AWG.
2. Class 2 low-energy, remote-control, and signal circuits; No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm, and signal circuits; No. 12 AWG.

3.5 FIRESTOPPING

A. Comply with requirements in Section 078400 "Firestopping."

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping" Chapter.

3.6 GROUNDING

A. For control-voltage wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.7 IDENTIFICATION

A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Identify data and communications system components, wiring, and cabling according to TIA-606-B; label printers must use label stocks, laminating adhesives, and inks complying with UL 969.

C. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire must have a unique tag.

3.8 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Visually inspect cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination, but not after cross-connection.

    a. Test instruments must meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in its "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in its "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

B. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

C. End-to-end cabling will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 260523

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes grounding and bonding systems and equipment.

B. Section includes grounding and bonding systems and equipment, plus the following special applications:
   1. Installation and Bonding of Grounding Electrodes including:
      a. Metal Underground Water Pipe
      b. Metal Frame of the Structure
      c. Concrete-Encased Electrodes including UFER Grounds
      d. Ground Ring
      e. Rod Electrodes
   2. Ground bonding common with lightning protection system.
   3. Foundation steel electrodes.
   4. Electrical Room Ground Bus.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

A. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
   1. Test wells.
   2. Grounding Electrodes
   3. Bonding Jumpers
   4. Electrical Room Grounding Bus.
   5. TEC and TDR Grounding Bus.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

a. Instructions for periodic testing and inspection of grounding features at test wells based on NFPA 70B.
   1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
   2) Include recommended testing intervals.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 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.

2.2 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:
   1. Stranded Conductors: ASTM B 8.
   2. Tinned Conductors: ASTM B 33.
   3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.

C. Electrical Room 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. Length as required for all specified terminations plus 25% spare but not less than 20 inches.

D. TEC and TDR 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. Length as required for all specified terminations plus 25% spare but not less than 12 inches.

2.3 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.

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.

2.4 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet (19 mm by 3 m).

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install stranded conductors unless otherwise indicated.

B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 4/0 AWG minimum.
1. Bury at least 18 inches (600 mm) below grade.

C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

D. Grounding Bus: Install in Normal Power Electrical Room, Essential Power Electrical Room, TEC and all TDR. Install bus horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 96 inches (2400 mm) above finished floor unless otherwise indicated.

E. Conductor Terminations and Connections:
1. Pipe 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.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Pad-Mounted Transformers and Switches: Install tinned-copper conductor not less than No. 4/0 AWG from equipment grounding terminals to ground ring. Bury ground ring not less 18 inches below finished grade.

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Armored and metal-clad cable runs.
8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
9. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.

C. 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.

D. 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.

E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

G. Metallic Fences: Comply with requirements of IEEE C2.
1. Grounding Conductor: Bare, tinned copper, not less than No. 8 AWG.
2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.

3.4 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 Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service

grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. 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.

D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are shall be at least 12 inches (300 mm) deep, with cover.
   1. Test Wells: Install one test well at the ground rod location indicated on the drawings.

E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through concrete footings.
   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
   2. Use exothermic-welded connectors; if a disconnect-type connection is required, use a bolted clamp.

F. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate interior and exterior columns at distances not more than 60 feet (18 m) apart.
   1.

G. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod.
   1. Install tinned-copper conductor not less than No. 4/0 AWG for bond to ground ring and for taps to building steel.
   2. Bury ground ring not less than 24 inches (600 mm) from building's foundation.

H. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 4/0 AWG.
   1. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within base of foundation.
   2. Bond grounding conductor to reinforcing steel in at least four locations in mat footing and at four spread footing locations evenly distributed throughout building. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

I. 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.

J. Panelboard Bonding: To comply with NEC 517.14 panelboard bonding requirements install a minimum #10 AWG copper conductor between all branch-circuit panelboard grounding terminal buses in each electrical room. The conductor may be installed in ½" EMT conduit or may be exposed where securely fastened to the walls.

3.5 FIELD QUALITY CONTROL

A. 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 conductor, at ground test wells, 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.

B. Grounding system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

D. Report measured ground resistances that exceed 3 ohms.

E. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

B. Related Requirements:
1. Section 260548.16 "Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
   a. Hangers.
   b. Steel slotted support systems.
   c. Nonmetallic support systems.
   d. Trapeze hangers.
   e. Clamps.
   f. Turnbuckles.
   g. Sockets.
   h. Eye nuts.
   i. Saddles.
   j. Brackets.
2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. For fabrication and installation details for electrical hangers and support systems.
1. Trapeze hangers. Include product data for components.
2. Steel slotted-channel systems.
3.
4. Nonmetallic slotted-channel systems.
5. Equipment supports.
6. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal: For hangers and supports for electrical systems.
1. Include design calculations and details of trapeze hangers.

2. Include design calculations for seismic restraints.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Suspended ceiling components.
   2. Structural members to which hangers and supports will be attached.
   3. Size and location of initial access modules for acoustical tile.
   4. Items penetrating finished ceiling, including the following:
      a. Lighting fixtures and lighting control.
      b. Electrical power devices
      c. Communications devices.
      d. Air outlets and inlets.
      e. Speakers.
      f. Fire sprinklers.
      g. Access panels.
      h. Projectors.
      i. Fire alarm system devices.
      j. Nurse call system devices.

B. Seismic Qualification Certificates: For hangers and supports for electrical equipment and systems, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design hanger and support system.

B. 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 system will be fully operational after the seismic event."
   2. Component Importance Factor: 1.5.

C. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame Rating: Class 1.
   2. Self-extinguishing according to ASTM D 635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4 factory-fabricated components for field assembly.
   1. Material: Galvanized steel.
   2. Channel Width: Use 1-1/4 inches (31.75 mm) where possible and minimum 13/16 inches (20.64 mm) where necessary due to space restrictions.
   3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
   4. Channel Dimensions: Selected for applicable load criteria.

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 electrical conductors 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 and are limited to 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, stainless 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. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 05 50 00 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems unless requirements in this Section are stricter.

B. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as scheduled in NECA 1, where Table 1 lists maximum spacings that are less than those stated in NFPA 70. Minimum rod size shall be 3/8 inch (9 mm) in diameter.

D. Multiple Raceways: 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 single-bolt conduit clamps.

E. 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.

3.2 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, EMTs, IMCs, and RMCs may be supported by openings through structure members, according to NFPA 70. Only prefabricated openings in structure members may be used. Do not create openings in structure members unless directed to do so by the structural engineer of record.

C. Cable Support Methods: Cables used for Circuits and Equipment Operating at Less Than 50 Volts and Class 1, 2 or 3 Remote-Control, Signaling and Power-Limited Circuits shall be installed in J-hooks. Where cables extend from J-hooks to equipment cables shall be supported from the structure by straps, hangers, cable ties or similar fittings designed and installed so as not to damage the cable. Do not fasten or secure cables to the raceways of the power system.

D. 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).

E. 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 13/16 inches (20.64 mm) slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.

F. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 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. Concrete materials, reinforcement, and placement requirements are specified in Section 03 30 00 "Cast-in-Place Concrete" or Section 03 30 53 "Miscellaneous Cast-in-Place Concrete."

C. Anchor equipment to concrete base as follows:
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.

3.5 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 minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Comply with requirements in Section 09 91 13 "Exterior Painting", Section 099123 "Interior Painting" and Section 099600 "High-Performance Coatings" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 26 05 33
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Surface raceways.
5. Boxes, enclosures, and cabinets.
6. Handholes and boxes for exterior underground cabling.

B. Related Requirements:
1. Section 26 05 43 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.3 DEFINITIONS

A. ARC: Aluminum Rigid Conduit.

B. EMT: Electrical Metallic Tubing.

C. GRC: Galvanized rigid steel conduit.

D. IMC: Intermediate metal conduit.

E. RTRC: Reinforced Thermosetting Resin Conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For color coded EMT conduit, surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. LEED Submittals:
1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products 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."

C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Qualification Data: For professional engineer.

C. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.

D. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. 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.

B. GRC: Comply with ANSI C80.1 and UL 6.

C. ARC: Comply with ANSI C80.5 and UL 6A.

D. IMC: Comply with ANSI C80.6 and UL 1242.

E. EMT: Comply with ANSI C80.3 and UL 797. Factory applied color finish available in black, orange, green, purple, red, yellow, blue, and white. Refer to Specification Section 26 05 53 “Identification for Electrical Systems” for color coding of raceways.

F. FMC: Comply with UL 1; zinc-coated steel.

G. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:
   a. Material: Steel.
   b. Type: Set screw or compression.
3. 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.

I. Joint Compound for IMC, GRC, or ARC: 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.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Listing and Labeling: Nonmetallic 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.

B. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

C. Continuous HDPE: Comply with UL 651B.

D. RTRC: Comply with UL 1684A and NEMA TC 14.

E. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

F. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

G. Solvent cements and adhesive primers 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."

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 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.

B. 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.

C. Wireway Covers: Hinged type unless otherwise indicated.

D. Finish: Manufacturer's standard enamel finish.

2.4 RECEPTACLE RACEWAYS

A. Listing and Labeling: Receptacle raceways 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: Aluminum with snap-on covers complying with UL. Clear anodized finish.
   1. Raceways for receptacles only: Wiremold AL3300 series.
   2. Raceways for applications where both receptacles and data devices are installed in the raceway and at all laboratory locations: Wiremold ALA4800 series two-channel and dual-cover. Satin anodized finish.
   3. Provide duplex receptacles at 12 inches on center in all receptacle raceways. Provide GFCI receptacles as noted on drawings.

2.5 BOXES, ENCLOSURES, AND CABINETS

A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

E. Floor Boxes and Poke-Through Devices: Refer to Specification Section 26 27 26 “Wiring Devices” for floor boxes and poke-through devices

F. 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.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

I. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

J. Device Box Dimensions:
   1. Wiring Devices other than data or communications devices: Minimum 4 inches square by 2-1/8 inches deep with switch ring as required for the device configuration and wall or ceiling surface. Where light switches are indicated at a common location provide multi-gang boxes to accommodate the quantity and type of switches indicated. Where deeper boxes are required provide masonry type boxes which do not require a separate switch ring.
   2. Data and communications devices: Minimum 4-11/16 inches square by 3 inches deep with single-gang 5/8 inch deep (or deeper if wall or ceiling finish is deeper) ring.

K. Pull boxes behind monitors: Minimum 6 inches square by 3-1/2 inches deep with two-gang ring.

L. Gangable boxes are prohibited.

M. Partitions: Provide partitions to separate emergency system conductors from conductors or other systems, where voltage between adjacent switches exceeds 300 volts and where switches controlling Low Voltage Controllers for interface to Nurse Call systems are installed in common boxes with line voltage switches.

N. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250.
   1. Indoor: Type 1 with continuous-hinge cover with flush latch unless otherwise indicated. Steel, finished inside and out with manufacturer's standard enamel.
   2. Outdoor: Type 4X with continuous-hinge cover with flush latch unless otherwise indicated. 304 stainless steel with smooth brushed finish.
   3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel. Provide interior panels when there are control devices or power blocks located inside the enclosure.

O. Handholes and Boxes for Exterior Underground Wiring: Refer to Specification Section 26 05 43 "Underground Ducts and Raceways for Electrical Systems".

2.6 PUTTY PADS

A. Moldable intumescent wall opening-protective pads designed for application to the back of electrical outlet boxes prior to installation of the wall finish to provide up to 2-hour fire barrier ratings and minimum Sound Transmission Class (STC) of 52 when tested in an STC-53 rated wall assembly or 59 according to ASTM E90-97.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. 3M Company.
   2. Hilti

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
   1. Exposed Conduit: GRC or IMC.
   2. Concealed Conduit, Aboveground: EMT.
   3. Underground Conduit for branch circuits: RNC, Type EPC-40-PVC, direct buried.
   4. Underground Conduit for feeders: Refer to Specification Section 26 05 43 "Underground Ducts and Raceways for Electrical Systems".
   5. Raceways Embedded in slabs or composite steel and concrete decks are prohibited.
   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 4X, 304 stainless steel.

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 or IMC. Raceway locations include the following:
      a. Loading dock.
      b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
      c. Mechanical rooms below 8 feet.
      d. Gymnasiums.
   4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
   5. Feeder Raceways under Slabs: RNC, Type EPC-40-PVC encased in not less than 2 inches of 3000 psi concrete. Change from RNC, Type EPC-40-PVC to GRC or IMC before rising above floor.

6. Branch Circuit Raceways under Slabs: Refer to Specifications Section 26 05 19 “Low-Voltage Electrical Power Conductors and Cables” for allowable application of under slab raceways. RNC, Type EPC-40-PVC direct buried. Change from RNC, Type EPC-40-PVC to GRC or IMC before rising above floor.
7. Raceways Embedded in slabs or composite steel and concrete decks are prohibited.
8. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
9. Damp or Wet Locations: GRC or IMC.
10. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4X, 304 stainless steel in kitchens and damp or wet locations.
11.

C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

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. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

G. Install surface raceways only where indicated on Drawings.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Separation of Life Safety and Critical Branch Wiring: Comply with NFPA 70 Article 517.

C. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

D. Complete raceway installation before starting conductor installation.

E. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.

F. Arrange stub-ups so curved portions of bends are not visible above finished slab except where concealed in chases.

G. 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 (300 mm) of changes in direction.

H. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

I. Support conduit within 12 inches (300 mm) of enclosures to which attached.

J. Raceways Embedded in Slabs are prohibited.

K. Stub-ups to Above Recessed Ceilings:
1. Use EMT, IMC, or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

L. 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.

M. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

N. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

O. 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 (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

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 (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

S. 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 (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

T. Surface Raceways:
1. Install surface raceway with a minimum 2-inch (50-mm)radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) 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.

U. 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. Install raceway sealing fittings according to NFPA 70.

V. 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:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

W. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

X. Expansion(Seismic)-Joint Fittings:
1. Install flexible metal conduit at all locations where conduits cross building or structure expansion joints. Allow for minimum 4 inches deflection in all directions or greater if expansion joint exceeds 4 inches. Provide droop in flexible conduit to accommodate movement. Do not loop the flexible conduit. When calculating total bend degrees in conduit runs with expansion fittings use minimum 60 degrees for each expansion-joint fitting
2. 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 (1830 mm) 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.

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 box and cover plate or 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.

3.3 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."

3.4 FIRESTOPPING AND SOUND TRANSMISSION MITIGATION

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

B. Install putty pads with acoustical and firestopping capabilities on all boxes that are installed in wall or partition cavities and in gypsum board ceilings.

3.5 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

SECTION 26 05 43
UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Spanish Fork Power Underground Power Construction Standards

1.2 SUMMARY

A. Section Includes:

1. Direct-buried conduit, ducts, and duct accessories.
2. Concrete-encased conduit, ducts, and duct accessories.
3. Transformer Pad/Vaults.

1.3 DEFINITIONS

A. RNC: Rigid Non-Metallic Conduit.

B. RTRC: Reinforced Thermosetting Resin Conduit (fiberglass).

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include duct-bank materials, including separators and miscellaneous components.
2. Include ducts and conduits and their accessories, including elbows, end bells, bends, and fittings.
3. Include warning tape.

B. Shop Drawings:

1. Precast or Factory-Fabricated Underground Utility Structures:

a. Include plans, elevations, sections, details, attachments to other work, and accessories.
b. Include duct entry provisions, including locations and duct sizes.
c. Include reinforcement details.
d. Include frame and cover design and pad-vault frame support rings.
e. Include grounding details.
f. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
g. Include joint details.

1.5 CLOSEOUT SUBMITTALS

A. Duct-Bank Record Drawings:
1. Indicate center line of each ductbank and conduit measured from a gridline.
2. Indicate elevation of each section of ductbank relative to the Hospital Building Level 1 Top-of- Slab elevation. Clearly identify all changes in elevation. Where ductbank is sloped provide a center line elevation at maximum every 10 feet.
3. Indicate location of crossings of piping of electrical and other systems.

1.6 FIELD CONDITIONS

A. Ground Water: Assume ground-water level is 36 inches (900 mm) below ground surface unless a higher water table is noted on Drawings.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR DUCTS AND RACEWAYS

A. Comply with City of Spanish Fork Underground Power Construction Standards

B. Comply with ANSI C2.

2.2 CONDUIT

A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.

B. RNC, straight runs: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.3 NONMETALLIC DUCTS AND DUCT ACCESSORIES

A. Underground Plastic Utilities Duct: NEMA TC 2, UL 651, ASTM F 512, Type EPC-40, with matching fittings complying with NEMA TC 3 by same manufacturer as the duct.

B. Duct Accessories:

1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and size of ducts with which used, and selected to provide minimum duct spacing indicated while supporting ducts during concreting or backfilling.
2. Warning Tape: Underground-line warning tape specified in Section 26 05 53 "Identification for Electrical Systems."

2.4 PRECAST VAULTS FOR PAD MOUNT SWITCHGEAR

A. Comply with Spanish Fork Power Services Underground Power Construction Standards.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate layout and installation of ducts, pad-vaults with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.

B. Coordinate elevations of ducts and duct-bank entrances into pad-vaults 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 as required to suit field conditions and to ensure that duct runs drain to pad-vaults and as approved by Architect.

C. Clear and grub vegetation to be removed and protect vegetation to remain according to Section 31 10 00 "Site Clearing." Remove and stockpile topsoil for reapplication according to Section 31 10 00 "Site Clearing."

3.2 UNDERGROUND DUCT APPLICATION

A. Ducts for Electrical Cables More than 600 V: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank.

B. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank.

3.3 EARTHWORK

A. Excavation and Backfill: Comply with Section 31 20 00 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary top-soil, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 32 92 00 "Turf and Grasses" and Section 32 93 00 "Plants."

D. Cut and patch existing pavement in the path of underground ducts and utility structures according to the "Cutting and Patching" Article in Section 01 73 00 "Execution."

3.4 DUCT INSTALLATION

A. Install ducts according to NEMA TCB 2.

B. Slope: Pitch ducts a minimum slope of 1:300 down toward pad-vaults and away from buildings and equipment.

C. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches (1200 mm) for 4 inch conduits and 60 inches for 6 inch conduit both horizontally and vertically, at other locations unless otherwise indicated.

D. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

E. Duct Entrances to Pad-vaults: Use end bells, spaced approximately 10 inches (250 mm) o.c. for 6-inch (125-mm) ducts and 7.5 inches for 4-inch ducts.

1. Begin change from regular spacing to end-bell spacing 10 feet (3 m) from the end bell without reducing duct line slope and without forming a trap in the line.
2. Grout end bells into structure walls from both sides to provide watertight entrances.

F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.

G. Pulling Cord: Install 100-lbf- (445-N-) test nylon cord in empty ducts.

H. Concrete-Encased Ducts: Support ducts on duct separators.

1. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Section 312000 "Earth Moving" for pipes less than or equal to 6 inches (150 mm) in nominal diameter.
2. Width: Excavate trench 4 inches (75 mm) wider than duct bank on each side.
3. Depth: Install top of duct bank at least 36 inches (600 mm) below finished grade except that tunnel crossing may be not less than 12” below top of slab. Where crossing grade beams install conduits at minimum 2 inches below bottom of grade beam.
4. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
5. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than four spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches (150 mm) between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
6. Minimum Space between Ducts: 3 inches (75 mm) between ducts and exterior envelope wall, 2 inches (50 mm) between ducts for like services, and 4 inches (100 mm) between power and signal ducts.
7. Minimum Center to Center dimension: 7.5 inches.
8. Elbows: Use manufactured RTRC conduit elbows for stub-ups at equipment and at changes of direction in duct run.

    a. Couple RTRC conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
9. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
10. Concrete Cover: Install a minimum of 4 inches (75 mm) of concrete cover at top and bottom, and a minimum of 2 inches (50 mm) on each side of duct bank.
11. Concreting Sequence: Pour each run of envelope between pad-vaults or other terminations in one continuous operation.

    a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.

b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch (15-mm) reinforcing-rod dowels extending a minimum of 18 inches (450 mm) into concrete on both sides of joint near corners of envelope.

12. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 033000 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.

I. Warning Tape: Bury warning tape approximately 12 inches (300 mm) above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches (75 mm) of centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.

3.5 INSTALLATION OF CONCRETE PADS AND VAULTS

A. Precast Concrete Pad-vault Installation:

1. Comply with ASTM C 891 unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting ducts, to minimize bends and deflections required for proper entrances.
3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch (25-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

B. Elevations:

1. Pad-vault Pad Lid: Install with pad at 4 inches above finished grade.

C. Drainage: Install drains in bottom of pad-vaults where indicated. Coordinate with drainage provisions indicated.

D. Dampproofing: Apply dampproofing to exterior surfaces of pad-vaults after concrete has cured at least three days. Dampproofing materials and installation are specified in Section 07 11 13 "Bituminous Dampproofing." After ducts are connected and grouted, and before backfilling, dampproof joints and connections, and touch up abrasions and scars.

E. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms,as required for installation and support of cables and conductors and as indicated.

F. Field-Installed Bolting Anchors in Pad-vaults: Do not drill deeper than 3-7/8 inches (97 mm) for pad-vaults for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

3.6 GROUNDING

A. Ground underground ducts and utility structures according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 6-inch- (150-mm-) long mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
3. Test pad-vault grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 26 0526 "Grounding and Bonding for Electrical Systems."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.8 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of pad-vaults, including sump. Remove foreign material.

END OF SECTION

SECTION 26 05 44
SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:
1. Section 07 84 13 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:
1. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit EQ 4: For sealants, documentation indicating that products 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."

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:
1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sleeves for Rectangular Openings:
1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:
   a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
   b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
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: Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
   1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
   2. Sealant shall have VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   3. 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."

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
   1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
      a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
      b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
   2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
   3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
   4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
   5. Install sleeves for floor penetrations. Extend sleeves installed in floors 4 inches above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
   1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
   2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels, including arc-flash warning labels.
8. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

D. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1 and IEEE C2.

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. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Use the following color code for all electrical equipment and junction boxes that areis specified to be labeled:
1. Standby Power Circuits: Black letters on red field.
2. Life Safety Branch Circuits: White letters on orange Field
3. Critical Branch Circuits: White letters on red Field
4. Equipment System Circuits: White letters on green field.
5. Normal Power Circuits: White letters on black field.
6. Uninterruptible Power Supply (UPS):
a. UPS-A: Blue letters on a grey field.White letters on gray field.
6.b. UPS-B: Red letters on a grey field.
7. Fire Alarm: Red letters on white field.
8. Communications: White letters on blue field.

B. 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 XX INCHES" where XX is replaced by the clearance requirements of NFPA 70.

C. Use the following color code for all electrical raceways that are specified to be labeledRaceways::
1. Labeling: Black on orange. Include system voltage and type.
2. Color Coding for Raceways:
D. Identify EMT conduits used for branch circuit wiring as follows:
1. Standby Power - Black
2. Life Safety Branch – Yellow
3. Critical Branch – Orange
4. Equipment Branch – Green
5. Normal – No Color
6. UPS - White
7. Fire alarm – Red
8. Communications - Blue
9. Access Control - Purple
10.
a. Fire Alarm: Red (BA2)Standby Power: Black
b. Life Safety Branch: Yellow
c. Critical Branch: Orange
d. Equipment Branch: Green
e. UPS: White
f. Fire alarm: Red

g. Communications: Blue
~~a.~~ Access Control: Purple
h.

3. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: where voltage, system type, or other written information is required, black lettering on orange background.

D. Labels on receptacle and switch cover plates shall match the respective plate color.

2.3 LABELS

A. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: printed, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

B. Indoor Equipment Labels: Self-adhesive, engraved, laminated acrylic or melamine plastic label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high. Color coded as indicated in Color and Legend Requirements.

C. Outdoor Equipment: Engraved, laminated acrylic or melamine plastic label, punched or drilled for mechanical fasteners. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high. Color coded as indicated in Color and Legend Requirements.

~~1. **Labeling: Black on orange. Include system voltage and type.**~~

~~C.~~

2.4 BANDS AND TUBES:

A. Snap-Around, Color-Coding Bands for Cables: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameters sized to suit diameters of raceways or cables they identify, and that stay in place by gripping action.

2.5 TAPES AND STENCILS:

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.6 SIGN~~Signs~~

A. Laminated Acrylic or Melamine Plastic Signs:
1. Engraved legend.
2. Thickness:
   a. For signs up to 20 sq. inches (129 sq. cm), minimum 1/16-inch- (1.6-mm-).
   b. For signs larger than 20 sq. inches (129 sq. cm), 1/8 inch (3.2 mm) thick.
   c. Engraved legend with white letters on a dark grey background.
   d. Punched or drilled for mechanical fasteners.

e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.7 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

3.1 PREPARATION

A. 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.

3.2 INSTALLATION

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. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. 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.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

G. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

H. System Identification for Feeder Raceways: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

~~H.~~I. Fire Alarm: Provide raceway with factory applied finish or paint conduit in field.

~~I.~~J. 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.

3.3 IDENTIFICATION SCHEDULE

A. Switchboards and Panelboards: Include Identification per the One-Line Diagrams and the Source Location, including the circuit number.

B. Disconnect Switches, Enclosed Circuits Breakers and Motor Controllers. Identify the equipment that is controlled and the Source, including the circuit number.

C. Accessible Raceways, including above accessible ceilings, for all Feeder Circuits and for Branch Circuit rated more than 30A: Identify with self-adhesive tape or vinyl label. Install labels at 30-foot (10-m) maximum intervals.

D. Accessible Raceways and Cables, including above accessible ceilings, within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels indicating ~~containing~~ the wiring system ~~legend~~ and system voltage. ~~System legends shall be as follows~~ Conform to system color legend/schedule.~~:~~

1. Standby Power
2. Life Safety Branch
3. Critical Branch
4. Equipment System
5. Normal Power
6. UPS
7. Fire Alarm
8. Communications
9. Access Control

~~E. Identify EMT conduits used for branch circuit wiring as follows:~~

~~1.~~F. ~~Standby Power - Black~~

~~2.~~G. ~~Life Safety Branch – Yellow~~

~~3.~~H. ~~Critical Branch – Orange~~

~~4.~~I. ~~Equipment Branch – Green~~

~~5.~~J. ~~Normal – No Color~~

~~6.~~K. ~~UPS - White~~

~~7.~~L. ~~Fire alarm – Red~~

~~8.~~M. ~~Communications - Blue~~

~~9.~~N. ~~Access Control - Purple~~

~~F.~~O. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Grounded Systems: Color-Coding for Phase- , Neutral- and Voltage-Level Identification: Use colors listed below for feeder and branch-circuit conductors.
   a. Colors for 208/120-V Circuits:
      1) Phase A: Black.
      2) Phase B: Red.
      3) Phase C: Blue.
      4) Feeder Neutral: White
      5) Branch Circuit Neutral: White with colored stripe matching the color of the phase circuit that is paired with the neutral.
   b. Colors for 480/277-V Circuits:
      1) Phase A: Brown.
      2) Phase B: Orange.
      3) Phase C: Yellow.
      4) Feeder Neutral: Grey
      5) Branch Circuit Neutral: Grey with colored stripe matching the color of the phase circuit that is paired with the neutral.
2. Isolated Power Systems: Color-Coding for Circuit Identification: Use colors listed below for Isolated Power conductors.
   a. Isolated Conductor No.1: Orange with at least one distinctive colored stripe other than white, green, or grey along the entire length of the conductor.
   b. Isolated Conductor No. 2: Brown with at least one distinctive colored stripe other than white, green, or grey along the entire length of the conductor.
3. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
   a. Field-Applied, Color-Coding Conductor Tape: 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.
4. Provide a sign at each panelboard identifying the color coding scheme.

~~G.~~P. Install instructional sign, including the color code for grounded and ungrounded conductors using adhesive-film-type labels.

~~H.~~Q. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive vinyl labels with the conductor or cable designation, origin, and destination.

~~I.~~R. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive vinyl labels with the conductor designation.

~~J.~~S. Conductors To Be Extended in the Future: Attach write-on tags to conductors and list source.

~~K.~~T. 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 operation and maintenance manual.

~~L.~~U. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
1. Limit use of underground-line warning tape to direct-buried cables.

2. Install underground-line warning tape for direct-buried cables and cables in raceways.

~~M.~~V. Workspace Indication: Install floor marking tape to 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.

~~N.~~W. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. 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.

~~O.~~X. Arc Flash Warning Labeling: Self-adhesive thermal transfer vinyl labels.
1. Comply with NFPA 70E and ANSI Z535.4.
2. Comply with Section 26 05 74 "Overcurrent Protective Device Arc-Flash Study" requirements for arc-flash warning labels.

~~P.~~Y. 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.

~~Q.~~Z. Emergency Operating Instruction Signs: Install instruction 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 or load shedding.

~~R.~~AA. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm unless equipment is provided with its own identification.
1. Labeling Instructions:
   a. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
   b. Fasten mechanically fastened labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
2. Equipment To Be Labeled:
   a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer.
   b. Enclosures and electrical cabinets.
   c. Lighting control relay cabinets.
   d. Access doors and panels for concealed electrical items.
   e. Switchgear.
   f. Switchboards.
   g. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
   h. Emergency system boxes and enclosures.
   i. Motor-control centers.
   j. Enclosed switches.

k. Enclosed circuit breakers.
l. Enclosed controllers.
m. Variable-speed controllers.
n. Push-button stations.
o. Power-transfer equipment.
p. Contactors.
q. Remote-controlled switches, dimmer modules, and control devices.
r. Battery-inverter units.
s. Battery racks.
t. Power-generating units.
u. Monitoring and control equipment.
v. UPS equipment.
w. Communications Equipment Racks.
x. Fire Alarm System.
y. Access Control System.
z. Overhead Paging System.
aa. Nurse Call System.

END OF SECTION

SECTION 26 09 23
LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Photoelectric switches.
2. Standalone daylight-harvesting switching controls.
3. Daylight-harvesting dimming controls.
4. Room Controllers.
5. Stand Alone Indoor occupancy sensors.
6. Lighting contactors.
7. Emergency shunt relays.
8. Low-Voltage Controllers

B. Related Requirements:
1. Section 26 27 26 "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, low voltage dimmers, low voltage switches, and manual light switches.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.
1. Submit complete scale drawing showing recommended location for each sensor, optimized for project conditions and coverage patterns for submitted devices.
2. Interconnection diagrams showing field-installed wiring.
3. Include diagrams for power, signal, and control wiring.
4. Include legend for each light switch keyed to the lighting control shop drawings indicating engraving/labelling factory applied to each switch.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 OUTDOOR PHOTOELECTRIC SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Industries, Inc.
2. Intermatic, Inc.
3. Leviton Manufacturing Co., Inc.
4. NSi Industries LLC.
5. TE Connectivity Ltd.

B. Description: Solid state, with SPST dry contacts rated for 1800 VA, to operate connected load, complying with UL 773.
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.
3. Time Delay: Thirty-second minimum, to prevent false operation.
4. Lightning Arrester: Air-gap type.
5. Mounting: Twist lock complying with NEMA C136.10, with base.

2.2 DAYLIGHT-HARVESTING SWITCHING CONTROLS

A. Provide products that are of the same manufacturer or compatible with the manufacturers listed in Section 26 09 43, Relay Based Lighting Controls.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton (Cooper Controls), Inc.
2. Lutron, Inc.
3. Leviton Manufacturing Co., Inc.
4. Philips Controls
5. Acuity Controls
6. Nextlite
7. ETC
8. Douglas Controls
9. WattStopper

C. Ceiling-Mounted Switching Controls: Solid-state, light-level sensor unit, with separate power pack, to detect changes in indoor lighting levels that are perceived by the eye.

D. Electrical Components, Devices, and Accessories:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).
3. Sensor Output: Contacts rated to operate the associated power pack, complying with UL 773A. Sensor is powered by the power pack.
4. Power Pack: Dry contacts rated for **20**-A ballast load at 120- and 277-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
5. General Space Sensors Light-Level Monitoring Range: 10 to 200 fc (108 to 2152 lux), with an adjustment for turn-on and turn-off levels within that range.

6. Atrium Space Sensors Light-Level Monitoring Range: 100 to 1000 fc (1080 to 10 800 lux), with an adjustment for turn-on and turn-off levels within that range.
7. Skylight Sensors Light-Level Monitoring Range: 1000 to 10,000 fc (10 800 to 108 000 lux), with an adjustment for turn-on and turn-off levels within that range.
8. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling.
9. Set-Point Adjustment: Equip with deadband adjustment of 25, 50, and 75 percent above the "on" set point, or provide with separate adjustable "on" and "off" set points.
10. Test Mode: User selectable, overriding programmed time delay to allow settings check.
11. Control Load Status: User selectable to confirm that load wiring is correct.
12. Indicator: Two digital displays to indicate the beginning of on-off cycles.

2.3 DAYLIGHT-HARVESTING DIMMING CONTROLS

A. Provide products that are of the same manufacturer or compatible with the manufacturers listed in Section 26 09 43, Relay Based Lighting Controls.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton (Cooper Controls), Inc.
2. Lutron, Inc.
3. Leviton Manufacturing Co., Inc.
4. Philips Controls
5. Acuity Controls
6. NextLite
7. Douglas Controls
8. ETC
9. WattStopper

C. System Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, the lights are dimmed.
1. Lighting control set point is based on two lighting conditions:
   a. When no daylight is present (target level).
   b. When significant daylight is present.
2. System programming is done with two hand-held, remote-control tools.
   a. Initial setup tool.
   b. Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.

D. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with separate controller unit, to detect changes in lighting levels that are perceived by the eye. The separate dimming control may be located in the appropriate relay cabint for these circuits.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Sensor Output: 0- to 10-V dc to operate electronic dimming ballasts. Sensor is powered by controller unit.
3. Power Pack: Sensor has 24-V dc, Class 2 power source, as defined by NFPA 70.
4. Light-Level Sensor Set-Point Adjustment Range: 20 to 100 fc (120 to 600 lux).

2.4 ROOM CONTROLLERS

A. Room Controllers are used to independently control lighting and switched receptacles.

B. Provide products that are compatible with Indoor Occupancy Sensors.

C. Digitally addressable room controller with the following functions.
1. Autonomous space control.
2. Networking to a central Dialog control system.
3. Networking to a central BACnet based management system.

D. The Room Controller shall consist of:
1. A universal voltage type (120Vac/277Vac/347Vac) power supply.
2. Four 20A rated relays complete with manual override. Circuit Load rating dependent on usage. One circuit dedicated for 20A receptacle control.
3. Four 0-10V control channels, capable of 100mA current sinking
4. A port to connect downstream switches, occupancy sensors and daylight sensors.
5. A port to connect upstream to BACnet IP building management system. The Controller shall communicate using native BACnet command objects appropriate for the application.
6. An indicating LED to aid in locating the controller in a darkened ceiling space.
7. Circuit testing buttons
8. Capable of connecting with WUL-3924
9. Output 24Vac 120mA
10. Relay Ratings
    a. 20A Suitable for General Purpose Loads @ 120/277 VAC
    b. 20A Suitable for Standard Ballasts and Tungsten Loads @ 120/277 VAC
    c. 16A Suitable for Electronic Ballasts @ 120/277 VAC
    d. 0.5HP @120/277 VAC.
11. The Room Controller relays shall be connected such that 120Vac plug load(s) and 277Vac lighting loads can be switched by a single Controller with no additional add-ons or remote modules
12. The Room Controller shall mount to electrical junction box via threaded ½" chase nipple. No other mounting hardware shall be required.
13. Switches shall connect to the lighting control network via a common low voltage, 2-wire, non-polarized data line.
    a. Switches shall be factory configured and programmed to control one or more outputs in the lighting control system.
    b. Switches can be programmed for preset control to set a specific lighting scene.
    c. Switches, with LED indicators to indicate both ON and OFF output/group status, shall be available with 2 or 4 single button switches per gang. Switch to fit standard Decora opening.
    d. Switches and switch hardware shall mount to standard wall boxes.
    e. Each switch shall provide a location for a label to identify function. The label shall be under a clear plastic cover and shall be field replaceable should the operation of the switch change. Permanently etched switches are not acceptable.
14. Dimmer switches shall be connected to the lighting control network via a common low voltage 2-wire, non-polarized data line.
    a. Dimmer switches shall be capable of raising or lowering light levels of individual or groups of lighting fixtures.
    b. Dimmer switches shall be capable of controlling across the full range of dimming settings within a period of three (3) seconds.
15. Space Control Requirements:
    a. Provide manual-on / auto-off control for lighting in all spaces that are controlled by a Room Controller.
    b. Provide auto-on / auto-off control for all switched receptacles that are controlled by a Room Controller.
    c. Provide auto-on / auto-off control for HVAC serving all spaces that contain a Room Controller. Control to be provided by either two-wire signal based on relay contact position or direct communication with the building management system

using BACnet commands. Coordinate with building management system installer.

16. Shall have a built in dimmer memory, the light output will remain at the previous setting when the lights are turned off and back on.

2.5 INDOOR OCCUPANCY SENSORS

A. Provide products that are of the same manufacturer or compatible with the manufacturers listed in Section 26 09 43, Relay Based Lighting Controls.

B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   2. Operation: 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.
   3. In locations where the sensor or the local switch is/are marked “VS” the sensor shall turn the lights off automatically upon room vacancy. The lights shall turn on only upon activation from the associated wall station.
   4. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
   5. Power Pack: 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.
   6. 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.
   7. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
   8. Bypass Switch: Override the "on" function in case of sensor failure.
   9. 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: Ceiling mounted; detect occupants in coverage area using both 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. 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. Remote powerpacks using one or more sensors shall be used to cover space as indicated on drawings.
   5. Device shall be vacancy sensing (in conjunction with local wall station) if marked “VS”. Otherwise device shall be occupancy sensing.

2.6 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

A. Provide products that are of the same manufacturer or compatible with the manufacturers listed in Section 260943, Relay Based Lighting Controls.

B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application**,**
2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).
3. Switch Rating: Not less than 800-VA LED at 120 V, 1200-VA LED loads at 277 V,

C. Wall-Switch Sensor:
1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft. (84 sq. m).
2. Sensing Technology: Dual technology - PIR and ultrasonic.
3. Switch Type: SP. SP, manual "on," automatic "off."
4. Voltage: Dual voltage, 120 and 277 V;
5. 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.
6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
7. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
8. Device shall be Vacancy sensing if marked VS or occupancy sensing if not otherwise marked.

2.7 LIGHTING CONTACTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Allen-Bradley/Rockwell Automation.
2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
3. Eaton Corporation.
4. GE Industrial Systems; Total Lighting Control.
5. Square D; a brand of Schneider Electric.

B. Description: Electrically operated, electrically held, combination-type lighting contactors with fusible switch 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 total harmonic distortion 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 control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

C. Interface with DDC System for HVAC: Provide hardware interface to enable the DDC system for HVAC to monitor and control lighting control systems and contactors.
1. Monitoring: On-off status
2. Control: On-off operation

2.8 EMERGENCY SHUNT RELAY

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton (Cooper Controls), Inc.
2. Lutron, Inc.
3. Leviton Manufacturing Co., Inc.
4. Philips Controls
5. Acuity Controls
6. NextLite
7. Douglas Controls
8. Wattstopper

B. Description: Normally closed, electrically held relay, arranged for wiring in parallel with automatic switching contacts; complying with UL 924.
1. Coil Rating: as scheduled.

2.9 LOW-VOLTAGE CONTROLLERS

A. Low-Voltage Controllers are used to turn on and dim line voltage lighting safely when used with Nurse Call Pillow Speakers, Bed Side-Rail Controls and Momentary Dry Contact Switches.

B. Manufacturers: Subject to compliance with requirements, provide the following:
1. Curbell Medical Products (Basis of Design is # LVC-2000-001)

C. Description: 3 Channel lighting controller to continuously dim 2 channels using 0-10 vdc signals to the dimming LED drivers for the ambient light and reading light channels in the luminaire and to switch one channel via the LED driver(s) for the exam light portion of the luminaire. Controller shall have control inputs from nurse call pillow speaker contacts and also be switched from wall switches as shown.

D. Installation: Lighting Controller shall be installed above the accessible ceiling outside the patient room for ease of access. All leads shall be extended from the switches, luminaire and nurse call system in an approved manner. Installer shall provide a NEMA 12 enclosure suitable for the purpose and mount the controller in this box. Observe required high and low voltage separation and physical barriers. Label the cover with the words “LIGHTING CONTROLLER FOR ROOM ####”.

2.10 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: Multiconductor cable with stranded-copper conductors not smaller than No. 22 AWG. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor 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."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. 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.

B. 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.

3.2 CONTACTOR INSTALLATION

A. 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.

3.3 WIRING INSTALLATION

A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "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.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified commissioning agent to evaluate lighting control devices and perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   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.

D. Lighting control devices will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within **12** months from date of Substantial Completion, provide on-site assistance in adjusting sensors 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.

3.7 DEMONSTRATION

A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control systems specified in Section 260943.13 "Addressable-Fixture Lighting Controls" and Section 26 09 43 "Relay-Based Lighting Controls."

B. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION

SECTION 26 09 36
STANDALONE MULTIPRESET MODULAR DIMMING CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Wall-box multiscene dimming controls.
   2. Multipreset modular dimming controls.

1.3 DEFINITIONS

A. Fade Rate: The time it takes each zone to arrive at the next scene, dependent on the degree of change in lighting level.

B. Low Voltage: As defined in NFPA 70, the term for circuits and equipment operating at less than 50 V or for remote-control, signaling, and power-limited circuits.

C. Scene: The lighting effect created by adjusting several zones of lighting to the desired intensity.

D. SCR: Silicon-controlled rectifier.

E. Zone: A fixture or group of fixtures controlled simultaneously as a single entity. Also known as a "channel."

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. For modular dimming controls; include elevation, dimensions, features, characteristics, ratings, and labels.
   2. Device plates and plate color and material.
   3. Ballasts and lamp combinations compatible with dimmers.

B. Shop Drawings:
   1. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: For master- and remote-control stations, and faceplates with factory-applied color finishes and technical features.

D. Samples for Verification: For master- and remote-control stations, and faceplates with factory-applied color finishes and technical features.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the requirements of the specifications and contract documents provide products from one of the following manufactures:
   1. Lutron Electronics
   2. Crestron Electronics
   3. Leviton
   4. Cooper Controls
   5. Acuity Controls

2.2 GENERAL DIMMING DEVICE REQUIREMENTS

A. Compatibility:
   1. Dimming control components shall be compatible with lighting fixtures, ballasts, and transformers, including DALI or other addressable digitally controlled LED drivers.
   2. Dimming control devices shall be compatible with lighting control system components specified in Section 26 09 43 "Relay-Based Lighting Controls," and in Section 26 09 23 "Lighting Control Devices."

B. Dimmers and Dimmer Modules: Comply with UL 508.
   1. Audible Noise and Radio-Frequency Interference Suppression: Solid-state dimmers shall operate smoothly over their operating ranges without audible lamp or dimmer noise or radio-frequency interference. Modules shall include integral or external filters to suppress audible noise and radio-frequency interference.
   2. Dimmer or Dimmer-Module Rating: Not less than 125 percent of connected load unless otherwise indicated.
   3. Shall have a built in dimmer memory, the light output will remain at the previous setting when the lights are turned off and back on.

C. Surge Protection: Withstand supply power surges without impairment to performance.
   1. Panels: 6000 V, 3000 A, complying with IEEE C62.41.1 and IEEE C62.41.2.
   2. Other System Devices: 6000 V, 3000 A, complying with IEEE C62.41.1 and IEEE C62.41.2.

D. Off Control Position: User-selected off position of any control point shall disconnect the load from line supply.

2.3 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 NFPA 70.

2.4 WALL-BOX MULTISCENE DIMMING CONTROLS

A. Description: Factory-fabricated equipment providing manual dimming consisting of a wall-box-mounted master controller and indicated number of wall-box zone stations. Controls and dimmers shall be integrated for mounting in multigang wall box under a single wall plate. Each zone shall be adjustable to indicated number of scenes, which shall reside in the memory of zone controller.

B. Each zone shall be configurable to control the following loads:
1. LED luminaires with electronic dimming drivers
2. Incandescent lamp dimmers driving high capacity LED dimming power modules.

C. Dimmers: Regulate voltages to maintain a constant light level, with no visible flicker, when the source voltage varies plus or minus 2 percent rms.

D. Memory:
1. Retain preset scenes and fade rates through momentary (up to 3-second) power interruptions.
2. Retain preset scenes through power failures for at least seven days.

E. Device Plates: Style, material, and color shall comply with Section 26 27 26 "Wiring Devices.". Master-control cover plate shall be one piece.

F. Master controller shall include the following:
1. Cover-mounted switches, including master off, all bright, and selectors for each scene.
2. Cover-mounted LED indicator lights, one associated with each scene switch, and one for the master off switch.
3. Concealed switches and indicators for specified function.
4. A raise/lower switch for each zone for temporary adjustments of the zone, without altering scene values stored in memory.
5. Fade time indicated by digital display for current scene while fading.
6. Cover-mounted infrared receiver.

G. Infrared Transmitters: Wireless remote control for recalling four of the presets. Operate up to 50 feet (15 m) within line of sight of the master controller.

2.5 CONDUCTORS AND CABLES

A. Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Class 2 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 24 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 WIRING INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch (13 mm).

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.2 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for identifying components and power and control wiring.

B. Label each dimmer module with a unique designation.

C. Label each scene control button with approved scene description.

3.3 FIELD QUALITY CONTROL

A. Comply with commissioning requirements in specification section 019113 -General Commissioning Requirements, and specification section 260800 (BA2)

B. Testing Agency: Owner will engage a qualified commissioning agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
1. Continuity tests of circuits.
2. Operational Test: Set and operate controls to demonstrate their functions and capabilities in a methodical sequence that cues and reproduces actual operating functions.
    a. Include testing of modular dimming control equipment under conditions that simulate actual operational conditions. Record control settings, operations, cues, and functional observations.

E. Remove and replace malfunctioning modular dimming control components and retest as specified above.

F. Test Labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.

G. Reports: Written reports of tests and observations. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain modular dimming controls. Laptop portable computer may be used in training.

B. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control system specified and Section 26 09 43 "Relay-Based Lighting Controls."

END OF SECTION

SECTION 26 09 43
RELAY-BASED LIGHTING CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes: Lighting control panels using mechanically held relays for switching with or without dimming modules.

B. Section Includes: Networked lighting control panels using control-voltage relays for switching and that are interoperable with DDC system for HVAC.

1.3 DEFINITIONS

A. DDC: Direct digital control.

B. IP: Internet protocol.

C. Dimming: a control signal generated by this panel that can control dimming properties of loads.

D. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.

E. PC: Personal computer; sometimes plural as "PCs."

F. RS-485: A serial network protocol, similar to RS-232, complying with TIA-485-A.

1.4 ACTION SUBMITTALS

A. Presubmittal meeting: Attend a coordination meeting to review all lighting control panels, control stations and control assignments prior to preparing submittal information.

B. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for control modules, power distribution components, relays, manual switches and plates, and conductors and cables.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

C. Shop Drawings: For each relay panel and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail wiring partition configuration, current, and voltage ratings.
4. Short-circuit current rating of relays.
5. Include diagrams for power, signal, and control wiring.
6. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.
7. Communications Protocol: Indicate communications protocol and coordination of protocol with BMS and other systems requiring connection to lighting control system.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in other Sections.
   1. Show interconnecting signal and control wiring, and interface devices that prove compatibility of inputs and outputs.
   2. For networked controls, list network protocols and provide statements from manufacturers that input and output devices comply with interoperability requirements of the network protocol.

B. Qualification Data: For testing agency.

C. Field quality-control reports.

D. Software licenses and upgrades required by and installed for operation and programming of digital and analog devices.

E. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lighting controls to include in emergency, operation, and maintenance manuals.

B. Software and Firmware Operational Documentation:
   1. Software operating and upgrade manuals.
   2. Program Software Backup: On magnetic media or compact disk, complete with data files.
   3. Device address list.
   4. Printout of software application and graphic screens.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Lighting Control Relays: Equal to 20 percent of amount installed, but no fewer than 24.
   2. Lighting Control Dimming Modules: Equal to 10 percent of amount installed, but no fewer than 4.
   3.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.
   1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Handle and prepare panels for installation according to NECA 407.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Input signal from field-mounted manual switches, or digital signal sources, shall open or close one or more lighting control relays in the lighting control panels. Any combination of inputs shall be programmable to any number of control relays.

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 47 CFR, Subparts A and B, for Class A digital devices.

D. Comply with UL 916.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Lighting control panels shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
   2. Component Importance Factor: 1.5.

B. Interface with DDC System for HVAC: Provide hardware and software to enable the DDC system for HVAC to monitor, control, display, and record data for use in processing reports.
   1. Hardwired Points:
      a. Monitoring: On-off status.
      b. Control: On-off operation.
   2. Communication Interface: Comply with ASHRAE 135. The communication interface shall enable the DDC system for HVAC operator to remotely control and monitor lighting from a DDC system for HVAC operator workstation. Control features and monitoring points displayed locally at lighting panel shall be available through the DDC system for HVAC.

2.3 LIGHTING CONTROL RELAY PANELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton (Cooper Controls), Inc.
   2. Lutron, Inc.
   3. Leviton Manufacturing Co., Inc.

4. Philips Controls
5. Acuity Controls
6. NextLite
7. ETC
8. Douglas Controls
9. Watt Stopper

B. Description: Standalone lighting control panel using mechanically latched relays to control lighting and appliances.

C. Lighting Control Panel:
1. A single enclosure with incoming lighting branch circuits, control circuits, switching relays, dimming modules and on-board timing and control unit.
2. A vertical barrier separating branch circuits from control wiring.

D. Control Unit: Contain the power supply and electronic control for operating and monitoring individual relays.
1. Timing Unit:
   a. 365-day calendar, astronomical clock, and automatic adjustments for daylight savings and leap year.
   b. Clock configurable for 12-hour (A.M./P.M.) or 24-hour format.
   c. Sixty four independent schedules, each having 24 time periods.
   d. Schedule periods settable to the minute.
   e. Day-of-week, day-of-month, day-of-year with one-time or repeating capability.
   f. 10 special date periods.
2. Sequencing Control with Override:
   a. Automatic sequenced on and off switching of selected relays at times set at the timing unit, allowing timed overrides from external switches.
   b. Sequencing control shall operate relays one at a time, completing the operation of all connected relays in not more than 10 seconds.
   c. Override control shall allow any relay connected to it to be switched on or off by a field-deployed manual switch or by an automatic switch, such as an occupancy sensor.
   d. Override control "blink warning" shall warn occupants approximately ten minutes before actuating the off sequence.
3. Nonvolatile memory shall retain all setup configurations. After a power failure, the controller shall automatically reboot and return to normal system operation, including accurate time of day and date.

E. Relays: Electrically operated, mechanically held single-pole switch, rated at 20 A at 120-V tungsten, 30 A at 277-V ballast, 1.5 hp at 120 V, and 3 hp at 277 V. Short-circuit current rating shall be not less than 14 kA. Control shall be three-wire, 24-V ac.

F. Power Supply: NFPA 70, Class 2, sized for connected equipment, plus 20 percent spare capacity. Powered from a dedicated branch circuit of the panelboard that supplies power to the line side of the relays, sized to provide control power for the local panel-mounted relays, bus system, low-voltage inputs, field-installed occupancy sensors, and photo sensors.

G. Operator Interface:
1. Integral alphanumeric keypad and digital display, and intuitive drop-down menus to assist in programming.
2. Log and display relay on-time.
3. Connect relays to one or more time and sequencing schemes.

2.4 NETWORKED LIGHTING CONTROL PANELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton (Cooper Controls), Inc.
2. Lutron, Inc.
3. Leviton Manufacturing Co., Inc.
4. Philips Controls
5. Acuity Controls
6. NextLite
7. ETC
8. Douglas Controls
9. WattStopper

B. Description: Lighting control panels using mechanically latched relays to control lighting and appliances. The panels shall be capable of being interconnected with digital communications to appear to the operator as a single lighting control system. Panel shall also contain 0-10vdc dimming modules ad UL 924 listed emergency lighting section as shown on the drawings.

C. Lighting Control Panels:
1. A single enclosure with incoming lighting branch circuits, control circuits, switching relays, dimming modules and on-board timing and control unit.
2. A vertical barrier separating branch circuits from control wiring.
3. A horizontal barrier separating normal and life safety circuits.

D. Main Control Unit: Installed in the main lighting control panel only; powered from the branch circuit of the standard control unit.
1. Ethernet Communications: Comply with TCP/IP protocol. The main control unit shall provide for programming of all control functions of the main and all networked slave lighting control panels including timing, sequencing, and overriding.
2. Compliance with ASHRAE 135: Controllers shall support serial MS/TP and Ethernet IP communications, and shall be able to communicate directly via DDC system for HVAC RS-485 serial networks and Ethernet 10Base-T networks as a native device and control 0-10vdc dimming circuits.
3. Web Server: Display information listed below over a standard Web-enabled server for displaying information over a standard browser.
   a. A secure, password-protected login screen for modifying operational parameters, accessible to authorized users via Web page interface.
   b. Panel summary showing the master and slave panels connected to the controller.
   c. Controller diagnostic information.
   d. Show front panel mimic screens for setting up controller parameters, input types, zones, and operating schedules. These mimic screens shall also allow direct breaker control and zone overrides.
4. Timing Unit:
   a. 365-day calendar, astronomical clock, and automatic adjustments for daylight savings and leap year.
   b. Clock configurable for 12-hour (A.M./P.M.) or 24-hour format.
   c. 64 independent schedules, each having 24 time periods.
   d. Schedule periods settable to the minute.
   e. Day-of-week, day-of-month, day-of-year with one-time or repeating capability.
   f. 16 special date periods.
5. Time Synchronization: The timing unit shall be updated not less than every hour with the network time server.
6. Sequencing Control with Override:
   a. Automatic sequenced on and off switching of selected relays at times set at the timing unit, allowing timed overrides from external switches or control stations.

b. Sequencing control shall operate relays and dimmer modules one at a time or in groups, completing the operation of all connected relays in not more than 10 seconds.
c. Override control shall allow any relay connected to it to be switched on or off by a field-deployed manual switch or by an automatic switch, such as an occupancy sensor.
d. Override control "blinking warning" shall warn occupants approximately before actuating the off sequence.
e. Controller shall operate the dimming modules in a preset mode, allowing full on, full off, high preset and low preset programming, with timed fades, (5 seconds to 2 minutes programmed fade transitions. These shall be indicated from the system clock or local manual control stations as shown on the drawings.
f. System shall control dimmed or switched circuits located in indicated daylight control zones as programmed to be limited by the daylight harvesting controllers.
g. System shall have inputs for manual control stations, occupancy sensors and daylight sensors as shown on the drawings.
h. Activity log, storing previous relay operation, including the time and cause of the change of status.
i. Download firmware to the latest version offered by manufacturer.

E. Standard Control Unit, installed in All Lighting Control Panels: Contain electronic controls for programming the operation of the relays in the control panel, contain the status of relays, and contain communications link to enable the digital functions of the main control unit. Comply with UL 916 and UL 924.
1. Electronic control for operating and monitoring individual relays and dimmers, and display relay on-time.
2. Nonvolatile memory shall retain all setup configurations. After a power failure, the controller shall automatically reboot and return to normal system operation.
3. Integral keypad and digital-display front panel for local setup, including the following:
a. Blink notice, time adjustable from software.
b. Ability to log and display relay on-time.
c. Capability for accepting downloadable firmware so that the latest production features may be added in the future without replacing the module.
d. Programming dimmed levels.

F. Relays: Electrically operated, mechanically held single-pole switch, rated at 20 A at 120-V tungsten, 30 A at 277-V ballast, 1.5 hp at 120 V, and 3 hp at 277 V. Short-circuit current rating shall be not less than 14 kA.

G. Dimming Modules: A control module that, in conjunction with a relay module, controls 0-10 vdc controllable LED drivers, 100 ma capacity. This is controllable from the relay control system and screens.

H. Power Supply: NFPA 70, Class 2, UL listed, sized for connected equipment, plus not less than 20 percent spare capacity. Powered from a dedicated branch circuit of the panelboard that supplies power to the line side of the relays, sized to provide control power for the local panel-mounted relays, bus system, low-voltage inputs, field-installed occupancy sensors, and low-voltage photo sensors.

I. Operator Interface: At the main control unit, provide interface for a tethered connection of a portable PC running MS Windows for configuring all networked lighting control panels using setup software designed for the specified operating system. Include one portable device for initial programming of the system and training of Owner's personnel. That device shall remain the property of Owner.

J. Software:

1. Menu-driven data entry.
2. Online and offline programming and editing.
3. Provide for entry of the room or space designation for the load side of each dimmer or relay.
4. Monitor and control all relays, showing actual relay state and the name of the automatic actuating control, if any.
5. Size the software appropriate to the system.

2.5 MANUAL SWITCHES AND PLATES

A. Push-Button Switches: Modular, momentary contact, three wire, for operating one or more relays and to override automatic controls.
   1. Match color and style specified in Section 262726 "Wiring Devices."
   2. Integral green LED pilot light to indicate when circuit is on.
   3. Internal white LED locator light to illuminate when circuit is off.
   4. Internal red LED locator light to illuminate pushbutton selection on preset stations.

B. Wall Plates: Single and multigang plates as specified in Section 26 27 26 "Wiring Devices."

C. Legend: Engraved or permanently silk-screened on wall plate where indicated. Use designations indicated on Drawings or noted on submittal drawings.

2.6 FIELD-MOUNTED SIGNAL SOURCES

A. Daylight Harvesting Switching Controls: Comply with Section 26 09 23 "Lighting Control Devices." Control power may be taken from the lighting control panel, and signal shall be compatible with the relays and dimmers.

B. Indoor Occupancy Sensors: Comply with Section 26 09 23 "Lighting Control Devices." Control power may be taken from the lighting control panel, and signal shall be compatible with the relays.

2.7 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cables: Multiconductor cable with copper conductors not smaller than No. 24 AWG, complying with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables. And compliant with manufacturer’s requirments"

C. Digital and Multiplexed Signal Cables: Unshielded, twisted-pair cable with copper conductors, complying with TIA/EIA-568-B.2, Category 6 for horizontal copper cable and with Section 271500 "Communications Horizontal Cabling."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panels according to NECA 407.

B. Examine panels before installation. Reject panels that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panels for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 WIRING INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Install cables in raceways within wall and above inaccessible ceilings. Install cable in J-hooks above accessible ceilings. Conceal raceways and cables except in unfinished spaces.
1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for raceways and boxes specified in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.3 PANEL INSTALLATION

A. Comply with NECA 1.

B. Install panels and accessories according to NECA 407.

C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

D. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

E. Mount panel cabinet plumb and rigid without distortion of box.

F. Install filler plates in unused spaces.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 26 05 53 "Identification for Electrical Systems."

C. Create a directory to indicate loads served by each relay; incorporate Owner's final room designations. Obtain approval before installing. Use a PC or typewriter to create directory; handwritten directories are unacceptable.

D. Lighting Control Panel Nameplates: Label each panel with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Comply with commissioning requirements in specification section 019113 -General Commissioning Requirements, and specification section 260800 (BA2)

B. Testing Agency: Owner will engage a qualified commissioning agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

E. Acceptance Testing Preparation:
1. Test continuity of each circuit.

F. Lighting control panel will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies lighting control panels and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.6 STARTUP SERVICE

A. Perform startup service.
1. Complete installation and startup checks according to manufacturer's written instructions.
2. Confirm correct communications wiring, initiate communications between panels, and program the lighting control system according to approved configuration schedules, time-of-day schedules, and input override assignments.
3. Verify proper operation of all daylight harvesting controls, all egress (emergency) lighting controls and local control stations.

3.7 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.8 SOFTWARE SERVICE AGREEMENT

A. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within five years from date of Substantial

Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.9 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain the control unit and operator interface.

END OF SECTION

SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. USB charger devices.
4. Isolated-ground receptacles.
5. Hospital-grade receptacles.
6. Tamper-resistant receptacles.
7. Weather-resistant receptacles.
8. Snap switches and wall-box dimmers.
9. Floor service outlets (floor boxes) and poke-through assemblies.
10. Pendant Cord Connector Devices (Drop Cords).
11. Cord Reels

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Receptacles for Owner-Furnished Equipment: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton (Arrow Hart).
2. Hubbell Incorporated; Wiring Device-Kellems.
3. Leviton Manufacturing Co., Inc.
4. Pass & Seymour/Legrand (Pass & Seymour).

B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 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. All devices must be manufactured for use with modular plug-in connectors, shall comply with UL 2459 and shall be made with stranded building wire. Devices shall comply with the requirements in this Section.

2.3 STRAIGHT-BLADE RECEPTACLES

A. Hospital-Grade, Tamper Resistant, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.
1. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap. Mechanical shutter system to help prevent insertion of foreign objects. Labeled shall comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

B. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
1. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

C. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.
   1. Description: Labeled shall comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

2.4 GFCI RECEPTACLES

A. General Description:
   1. Straight blade, non-feed-through type.
   2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
   3. Include indicator light that illuminates only when the GFCI has malfunctioned or tripped and no longer provides proper GFCI protection.

B. Tamper-Resistant GFCI Convenience Receptacles, 125 V, 20 A:

C. Hospital-Grade, Tamper Resistant, Duplex GFCI Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.

2.5 TWIST-LOCKING RECEPTACLES

A. Provide NEMA configurations as indicated on drawings.

2.6 PENDANT CORD-CONNECTOR DEVICES

A. Description:
   1. Matching, locking-type plug and receptacle body connector.
   2. NEMA WD 6 Configurations L5-20P and L5-20R, heavy-duty grade, and FS W-C-596.
   3. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.
   4. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.7 CORD REELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Kitchen Leash by APC Group

B. Description:
   1. Molded Polypropylene Housing.
   2. Retracting cord with adjustable stop.
   3. SJOW Power cord, 10 foot; rated 200 degrees.
   4. Receptacles Dual Duplex NEMA 5-20R unless noted otherwise.
   5. Impact: UL746C
   6. Hose Down: CSA 6.8.2
   7. Strain Relief: CSA 6.4
   8. Flame Retardant: UL 94-94V-2
   9. Mounting Bracket for ceiling mount.

2.8 CORD AND PLUG SETS

A. Description:
1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.9 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:
1. Single Pole and Three Way:

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

1) Eaton (Arrow Hart).
2) Hubbell Incorporated; Wiring Device-Kellems.
3) Leviton Manufacturing Co., Inc.
4) Pass & Seymour/Legrand (Pass & Seymour).

C. Key-Operated Switches, 120/277 V, 20 A:
1. Description: Single pole, with factory-supplied key in lieu of switch handle.
a. Public Restrooms and Other Spaces: Keyed switch, heavy duty specification grade (Pass & Seymour PS20AC1-WL or equivalent).
b. Behavioral Health Patient Accessible Spaces: Keyed locking switch, extra heavy duty specification grade security switch (Pass & Seymour PS20AC1-KL or equivalent). Coordinate common or differentiated keying of multiple switches with owner.

D. Momentary Contact Switches: 2-Button, Single Pole, Low-voltage switch, mounts in standard single gang ring.

E. Key-Operated, Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.

F. Decora style rocker switches are not permitted.

2.10 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

B. Control: Continuously adjustable full width slider; with single-pole or three-way switching. Comply with UL 1472.

C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module for off.
   1. These shall be used to control power modules driving large quantity of LED drivers using 0-10VDC control signals. This interface shall operate either 120 or 277 volt circuits, 200 ma rating.

D. Decora style rocker switches are not permitted.

E. LED and Low Voltage Dimmer Switches:
   1. Modular; compatible with LED drivers; trim potentiometer to adjust low-end dimming used where "LR" is shown, otherwise full range of 1% to 100% of lumen output or as noted.
   2. Maximum of four (4) buttons per gang.
   3. Dimmer shall operate either 120 or 277 volt circuits, 28 ma minimum rating.
   4. Touch dimming switches shall cover the full range of dimming with a single press-and-hold function in not more than three (3) seconds.
   5. Switches, with LED indicators to indicate both ON and OFF status, shall be available with 2 or 4 single button switches per gang. Switch to fit standard Decora opening.
   6. Switches and switch hardware shall mount to standard wall boxes.
   7. Each switch shall provide a location for a label to identify function. The label shall be under a clear plastic cover and shall be field replaceable should the operation of the switch change. Permanently etched switches are not acceptable unless specifically noted otherwise.

F. Slide Dimmer Locations:
   1. Exam Rooms, Imaging Rooms, Operating Rooms, Procedure Rooms, Recovery Bays, and Imaging Control Rooms: Provide slide dimmer switches; do not provide touch dimming switches in these spaces except when an integrated component of an antimicrobial or integrated operating room ceiling system.

2.11 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.
   1. Plate-Securing Screws (behavioral health spaces): Metal tamper resistant TORX screws with head color to match plate finish.
   2. Plate-Securing Screws (other than behavioral health spaces): Metal with head color to match plate finish.
   3. Material for Finished Spaces, except Operating Rooms, Food Service Kitchens, and Behavioral Health Spaces: Smooth, high-impact thermoplastic.
   4. Material for Operating Rooms and Food Service Kitchen: 0.035-inch- (1-mm-) thick, satin-finished, Type 302 stainless steel.
   5. Material for Behavioral Health Spaces: Smooth, nylon, unbreakable, with a minimum of two (2) screws per gang; provide Torx head tamper resistant screws.
   6. Material for Unfinished Spaces: Galvanized steel.
   7. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable, weatherproof-in-use cover.

2.12 FLOOR SERVICE FITTINGS

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

1. Wiremold / Legrand.

B. Type: Modular, flush-type, dual- or multi- service units suitable for wiring method used.

C. Compartments: Barrier separates power from voice and data communication cabling.

D. Service Plate: Round, die-cast aluminum with satin finish.

E. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.

F. Voice and Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 jacks for UTP cable complying with requirements in owner's Section 27 00 00 requirements.

G. Description by Device Type:

FB1	Flush, Dual Service, Furniture Feed. One .75" conduit for power and One 2" conduit for data cabling. See plans for circuits and data drops. Finish selected by architect.	Legrand EFBFF Hubbell CFB2G30/2GCFFCVR
FB4	Flush, Dual Service, one piece finish flange. Four gang capacity. One .75" conduit for power and one 2" conduit for data cabling. See plans for circuits and data drops. Finish selected by architect.	Legrand EFG45S Hubbell CFB2G30/24GCCVR
FB6	Flush, Dual Service, one piece finish flange. Six gang capacity. One .75" conduit for power and one 2" conduit for data cabling. See plans for circuits and data drops. Finish selected by architect.	Legrand EFB6S Evolution Hubbell CFB6G30/610GCCVR
FB8	Flush, Dual Service, one piece finish flange. Eight gang capacity. One .75" conduit for power and one 2" conduit for data cabling. See plans for circuits and data drops. Finish selected by architect.	Legrand EFB8S Evolution
FB10	Flush, Dual Service, one piece finish flange. Ten gang capacity. One .75" conduit for power and one 2" conduit for data cabling. See plans for circuits and data drops. Finish selected by architect.	Legrand EFB10S Evolution Hubbell CFB10G30/610GCCVR
FB11	Flush single service floor box suitable for the wiring method used. NEMA 5-20R duplex receptacle with brushed aluminum flange and cover plate. Hinged receptacle covers. Housing material shall be stamped steel above grade and cast iron at grade. Provide appropriate carpet and tile flanges.	Legrand 880MS(CS)/817/828 Hubbell B2431/S3825

2.13 POKE-THROUGH ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Wiremold / Legrand.

B. Description:
1. Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
2. Comply with UL 514 scrub water exclusion requirements.
3. Size: Selected to fit cored holes in floor and matched to floor thickness.
4. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
5. Closure Plug: Arranged to close unused cored openings and reestablish fire rating of floor.

C. Description by Device Type:

PT1	Flush, Dual Service, 4" Diameter Furniture Feed Poke-Thru. One piece finish flange. One .75" conduit for power, One 1.5" conduit for data cabling. See plans for circuits and data drops. Finish selected by architect.	Legrand 4FFATC Hubbell PT73FFS/FRF3
PT2	Flush, Dual Service Capable, 4"Diameter Poke-Thru. One .75" conduit for	Legrand 4AT Evolution

	power, one 1.5" conduit for data cabling. Two Gang Capacity. See plans for circuits and data drops. Receptacles shall be NEMA 5-20R, Finish selected by architect.	Hubbell S1R4PT
PT3	Flush, Dual Service Capable, 6"Diameter Poke-Thru. One .75" conduit for power, one 1.5" conduit for data cabling. Three Gang Capacity. See plans for circuits and data drops. Receptacles shall be NEMA 5-20R, Finish selected by architect.	Legrand 6AT Evolution Hubbell S1R6PT
PT8	Flush, Dual Service Capable, 8"Diameter Poke-Thru. One .75" conduit for power, one 2" conduit for data cabling. Five Gang Capacity. See plans for circuits and data drops. Receptacles shall be NEMA 5-20R, Finish selected by architect.	Legrand 8AT Evolution Hubbell S1R8PT
PT10	Flush, Dual Service Capable, 10"Diameter Poke-Thru. One .75" conduit for power, one 2" conduit for data cabling. Eight Gang Capacity. See plans for circuits and data drops. Receptacles shall be NEMA 5-20R, Finish selected by architect.	Legrand 10AT Evolution Hubbell S1R10PT
PT11	Flush single service floor box suitable for the wiring method used. NEMA 5-20R duplex receptacle with brushed aluminum flange and cover plate. Hinged receptacle covers.	Legrand RC7CTC Hubbell PT7FS/FRF

2.14 FINISHES

A. Device Color:
   1. Wiring Devices Connected to Normal Power System: Gray in Food Service Kitchen. As selected by Architect in other finished spaces unless otherwise indicated or required by NFPA 70 or device listing.
   2. Wiring Devices Connected to Essential Power System: Red.
   3. Isolated-Ground Receptacles: Orange.

B. Wall Plate Color:
   1. Plastic covers: Match device color.
   2. Cover plates for receptacles mounted above data racks in TEC and TDR rooms: Provide blue cover plates for receptacles served by UPS-A and red cover plates for receptacles served by UPS-B.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. 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.

C. 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. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. 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.

E. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. 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.

G. Dimmers:
1. Install dimmers within terms of their listing.
2. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.
3. Install 0-10VDC control wiring in conduit with power wiring. Use conductors with insulation equivalent to insulation of power wiring.

H. 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, multigang wall plates.

I. Adjust locations of floor boxes and pokethroughs to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
   2. Test Instruments: Use instruments that comply with UL 1436.
   3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

B. Tests for Convenience Receptacles:
   1. Line Voltage: Acceptable range is 105 to 132 V.
   2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
   3. Ground Impedance: Values of up to 2 ohms are acceptable.
   4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
   5. Using the test plug, verify that the device and its outlet box are securely mounted.
   6. 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.

C. Test straight-blade convenience outlets in patient-care areas for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz. (115 g). Submit test report indicting each receptacle and test result.

D. Wiring device will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION

SECTION 26 28 13
FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Cartridge fuses rated 600-V ac and less for use in enclosed switches, panelboards and enclosed controllers.,
2. Spare-fuse cabinets.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Fuse sizes for elevator feeders and elevator disconnect switches.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
1. Ambient temperature adjustment information.
2. Coordination charts and tables and related data.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

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 NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Comply with UL 248-11 for plug fuses.

1.7 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.8 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Bussmann, Inc.
2. Edison Fuse, Inc.
3. Ferraz Shawmut, Inc.
4. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2.3 PLUG FUSES

A. Characteristics: UL 248-11, nonrenewable plug fuses; 125-V ac.

2.4 PLUG-FUSE ADAPTERS

A. Characteristics: Adapters for using Type S, rejection-base plug fuses in Edison-base fuseholders or sockets; ampere ratings matching fuse ratings; irremovable once installed.

2.5 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:
1. Feeders: Class J, time delay.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install spare-fuse cabinet(s).

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION

SECTION 26 28 16
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Fusible switches.
2. Nonfusible switches.
3. Receptacle switches.
4. Shunt trip switches.
5. Molded-case circuit breakers (MCCBs).
6. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of NRTL listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.
1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Manufacturer's field service report.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.
1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. 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.

E. Comply with NFPA 70.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
2. Altitude: Not exceeding 6600 feet (2010 m).

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
1. Notify Owner no fewer than 2 weeks days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Owner's written permission.
4. Comply with NFPA 70E.

1.10 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

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

1. Eaton.
2. General Electric Company.
3. Siemens Industry, Inc.
4. Square D; by Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 240, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Lugs: Mechanical type, suitable for number, size, and conductor material.

6. Service-Rated Switches: Labeled for use as service equipment.
7. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac.

2.2 NONFUSIBLE SWITCHES

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

1. Eaton.
2. General Electric Company.
3. Siemens Industry, Inc.
4. Square D; by Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 240, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
4. Lugs: Mechanical type, suitable for number, size, and conductor material.
5. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac.

2.3 MOLDED-CASE CIRCUIT BREAKERS

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

1. Eaton.
2. General Electric Company.
3. Siemens Industry, Inc.
4. Square D; by Schneider Electric.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I^2t response.

F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

G. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

H. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

I. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

J. Features and Accessories:
1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

2.4 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Kitchen Locations (other than Wash Down Areas): NEMA 250, Type 4X, stainless steel.
4. Kitchen Wash Down Areas: NEMA 250, Type 4X, stainless steel.
5. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
6. Imaging Rooms: Flush Mount.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."
   1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
   2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Acceptance Testing Preparation:
   1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

C. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   3. Perform the following infrared scan tests and inspections and prepare reports:
      a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
      b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
      c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 05 73 "Overcurrent Protective Device Coordination Study."

END OF SECTION

SECTION 26 29 13
ENCLOSED COTNROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes the following enclosed controllers rated 600 V and less:
   1. Full-voltage magnetic.

B. Related Section:
   1. Section 26 29 23 "Variable-Frequency Motor Controllers" for general-purpose, ac, adjustable-frequency, pulse-width-modulated controllers for use on variable torque loads in ranges up to 200 hp.

1.3 DEFINITIONS

A. CPT: Control power transformer.

B. MCCB: Molded-case circuit breaker.

C. MCP: Motor circuit protector.

D. N.C.: Normally closed.

E. N.O.: Normally open.

F. OCPD: Overcurrent protective device.

G. SCR: Silicon-controlled rectifier.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed controllers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 ACTION SUBMITTALS

A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.

B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
   1. Show tabulations of the following:
      a. Each installed unit's type and details.
      b. Factory-installed devices.
      c. Nameplate legends.
      d. Short-circuit current rating of integrated unit.
      e. Listed and labeled for integrated short-circuit current (withstand) rating of OCPDs in combination controllers by an NRTL acceptable to authorities having jurisdiction.
      f. Features, characteristics, ratings, and factory settings of individual OCPDs in combination controllers.
   2. Wiring Diagrams: For power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Certificates: For enclosed controllers, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

D. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

E. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
   1. Routine maintenance requirements for enclosed controllers and installed components.
   2. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
   3. Manufacturer's written instructions for setting field-adjustable overload relays.
   4. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage solid-state controllers.

1.8 MATERIALS MAINTENANCE 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. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
   2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
   3. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
   4. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

1.9 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.
   1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

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.

D. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."

1.10 DELIVERY, STORAGE, AND HANDLING

A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.11 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
   1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
   2. Altitude: Not exceeding 6600 feet (2010 m).

B. Interruption of Existing Electrical Systems: Do not interrupt electrical systems in facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
   1. Notify Owner no fewer than two weeks in advance of proposed interruption of electrical systems.
   2. Indicate method of providing temporary utilities.
   3. Do not proceed with interruption of electrical systems without Owner's written permission.
   4. Comply with NFPA 70E.

1.12 COORDINATION

A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 FULL-VOLTAGE CONTROLLERS

A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.

B. Magnetic Controllers: Full voltage, across the line, electrically held.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Eaton.
   b. General Electric Company.
   c. Siemens Industry, Inc.
   d. Square D; by Schneider Electric.
2. Configuration: Nonreversing.
3. Contactor Coils: Pressure-encapsulated type.
   a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
4. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
5. Control Circuits: 120 -V ac; obtained from integral CPT, with primary and secondary fuses, with CPT control power source of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.
   a. CPT Spare Capacity: 50 VA.
6. Solid-State Overload Relay:
   a. Switch or dial selectable for motor running overload protection.
   b. Sensors in each phase.
   c. Class 20 tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
7. External overload reset push button.

2.2 ACCESSORIES

A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
1. Selector Switches: Heavy-duty, oiltight type.
   a. Pilot Lights: LED types; colors as indicated.
   b. Selector Switches: Rotary type.

B. Reversible N.C./N.O. auxiliary contact(s).

C. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."

B. Install fuses in each fusible-switch enclosed controller.

3.3 IDENTIFICATION

A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
   1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
   2. Label each enclosure with engraved nameplate.
   3. Label each enclosure-mounted control and pilot device.

3.4 CONTROL WIRING INSTALLATION

A. Install wiring between enclosed controllers and remote devices and facility's central control system.

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic-control selection devices where applicable.
   1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
   2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Acceptance Testing Preparation:
   1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

D. Tests and Inspections:
   1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
   2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
   3. Test continuity of each circuit.
   4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Owner before starting the motor(s).
   5. Test each motor for proper phase rotation.
   6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   8. Perform the following infrared (thermographic) scan tests and inspections and prepare reports:
      a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each multi-pole enclosed controller. Remove front panels so joints and connections are accessible to portable scanner.
      b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each multi-pole enclosed controller 11 months after date of Substantial Completion.
      c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

E. Enclosed controllers will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.

C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Owner before increasing settings.

D. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 05 73 "Overcurrent Protective Device Coordination Study."

END OF SECTION

SECTION 26 29 23
VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes separately enclosed, preassembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

1.3 DEFINITIONS

A. CE: Conformite Europeene (European Compliance).

B. CPT: Control power transformer.

C. DDC: Direct digital control.

D. EMI: Electromagnetic interference.

E. LED: Light-emitting diode.

F. NC: Normally closed.

G. NO: Normally open.

H. OCPD: Overcurrent protective device.

I. PID: Control action, proportional plus integral plus derivative.

J. RFI: Radio-frequency interference.

K. VFC: Variable-frequency motor controller.

L. VFD: Variable-frequency motor controller.

1.4 ACTION SUBMITTALS

A. Product Data: For each type and rating of VFC indicated.

1. Include dimensions and finishes for VFCs.

2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For each VFC indicated.

1. Include mounting and attachment details.

2. Include details of equipment 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.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Required working clearances and required area above and around VFCs.

2. Show VFC layout and relationships between electrical components and adjacent structural and mechanical elements.

3. Show support locations, type of support, and weight on each support.

4. Indicate field measurements.

B. Qualification Data: For testing agency.

C. Seismic Qualification Certificates: For each VFC, accessories, and components, from manufacturer.

1. Certificate of compliance.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.

D. Product Certificates: For each VFC from manufacturer.

E. Harmonic Analysis Report: Provide Project-specific calculations and manufacturer's statement of compliance with IEEE 519.

F. Source quality-control reports.

G. Field quality-control reports.

H. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
   a. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and motor-circuit protector trip settings.
   b. Manufacturer's written instructions for setting field-adjustable overload relays.
   c. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
   d. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
   e. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.
   f. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than five of each size and type.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.9 DELIVERY, STORAGE, AND HANDLING

A. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside controllers and install temporary electric heating, with at least 250 W per controller.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. ABB.

2. DanFoss.

3. Eaton.

4. Yaskawa Electric America, Inc.

2.2 SYSTEM DESCRIPTION

A. General Requirements for VFCs:

1. VFCs and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508C.

B. Application: variable torque.

C. VFC Description: Variable-frequency motor controller, consisting of power converter that employs pulse-width-modulated inverter, factory built and tested in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.

1. Units suitable for operation of NEMA MG 1, Design A and Design B motors, as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both" and operation of inverter-duty motors as defined by NEMA MG 1, Section IV, part 31, "Definite Purpose Inverter-Fed Polyphase Motors."

2. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.

D. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

E. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.

F. Unit Operating Requirements:

1. Input AC Voltage Tolerance: Plus 10 and minus 15 percent of VFC input voltage rating.

2. Input AC Voltage Unbalance: Not exceeding 5 percent.

3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.

4. Minimum Efficiency: 98% percent at 60 Hz, full load.

5. Minimum Displacement Primary-Side Power Factor: 98 percent under any load or speed condition.

6. Minimum Short-Circuit Current (Withstand) Rating: Not less than the rating of the switchboard or panelboard that supplies the controller.

7. Ambient Temperature Rating: Not less than 32 deg F (0 deg C) and not exceeding 104 deg F (40 deg C).

8. Humidity Rating: Less than 95 percent (noncondensing).

9. Altitude Rating: Not exceeding 3300 feet (1000 m).

10. Vibration Withstand: Comply with NEMA ICS 61800-2.

11. Overload Capability: 1.1 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.

12. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.

13. Speed Regulation: Plus or minus 5 percent.

14. Output Carrier Frequency: Selectable; 1 to 12.5 kHz.

15. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.

G. Inverter Logic: Microprocessor based, 32 bit, isolated from all power circuits.

H. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.

1. Signal: Optical.

I. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.

2. Maximum Speed: 80 to 100 percent of maximum rpm.

3. Acceleration: 0.1 to 999.9 seconds.

4. Deceleration: 0.1 to 999.9 seconds.

5. Current Limit: 30 to minimum of 150 percent of maximum rating.

J. Self-Protection and Reliability Features:

1. Surge Suppression: Factory installed as an integral part of the VFC, complying with UL 1449 SPD, Type 1 or Type 2.

2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.

3. Under- and overvoltage trips.

4. Inverter overcurrent trips.

5. VFC and Motor-Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor-overload alarm and trip; settings selectable via the keypad.

6. Critical frequency rejection, with three selectable, adjustable deadbands.

7. Instantaneous line-to-line and line-to-ground overcurrent trips.

8. Loss-of-phase protection.

9. Reverse-phase protection.

10. Short-circuit protection.

11. Motor-overtemperature fault.

K. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.

L. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.

M. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

N. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

O. Integral Input Disconnecting Means and OCPD: Any of the following are acceptable. Selection should be based upon requirements for Short-Circuit Current (Withstand) Rating. UL 489, instantaneous-trip circuit breaker, UL 489, molded-case switch, with power fuse block and current-limiting fuses, UL 489, thermal-magnetic circuit breaker, NEMA KS 1, nonfusible switch, with power fuse block and current-limiting fuses, NEMA KS 1, fusible switch with pad-lockable, door-mounted handle mechanism.

1. Disconnect Rating: Not less than 115 percent of VFC input current rating.

2. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFC input current rating, whichever is larger.

3. Auxiliary Contacts: NO or NC, arranged to activate before switch blades open.

4. Auxiliary contacts "a" and "b" arranged to activate with circuit-breaker handle.

5. NO alarm contact that operates only when circuit breaker has tripped.

2.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: VFCs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. The designated VFCs shall be tested and certified by an NRTL as meeting the ICC-ES AC 156 test procedure requirements.

1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.4 CONTROLS AND INDICATION

A. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English-language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.

1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.

2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.
   a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.

3. Indicating Devices: Digital display integral to the Operator Station to display VFC parameters including, but not limited to:
   a. Output frequency (Hz).
   b. Motor speed (rpm).
   c. Motor status (running, stop, fault).
   d. Motor current (amperes).
   e. Motor torque (percent).
   f. Fault or alarming status (code).
   g. PID feedback signal (percent).
   h. DC-link voltage (V dc).
   i. Set point frequency (Hz).
   j. Motor output voltage (V ac).

B. Historical Logging Information and Displays: Available through the Operator Station.

C. Control Signal Interfaces:

1. Electric Input Signal Interface:

a. A minimum of two programmable analog inputs: 0- to 10-V dc and 4- to 20-mA dc.

2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the DDC system for HVAC or other control systems:
   a. 0- to 10-V dc.
   b. 4- to 20-mA dc.
   c. Potentiometer using up/down digital inputs.
   d. Fixed frequencies using digital inputs.

3. Output Signal Interface: A minimum of two programmable analog output signal(s) 0- to 10-V dc and 4- to 20-mA dc), which can be configured for any of the following:
   a. Output frequency (Hz).
   b. Output current (load).
   c. DC-link voltage (V dc).
   d. Motor torque (percent).
   e. Motor speed (rpm).
   f. Set point frequency (Hz).

D. Interface with DDC System for HVAC: Factory-installed hardware and software shall interface with DDC system for HVAC to monitor, control, display, and record data for use in processing reports. VFC settings shall be retained within VFC's nonvolatile memory.

1. Communication Interface: Comply with ASHRAE 135. Communication shall interface with DDC system for HVAC to remotely control and monitor lighting from a DDC system for HVAC operator workstation. Control features and monitoring points displayed locally at lighting panel shall be available through the DDC system for HVAC.

2.5 LINE CONDITIONING AND FILTERING

A. Input Line Conditioning: Based on the manufacturer's harmonic analysis study and report, provide input filtering, as required, to limit total demand (harmonic current) distortion and total harmonic voltage demand at the defined point of common coupling to meet IEEE 519 recommendations.

B. EMI/RFI Filtering: Certify compliance with IEC 61800-3 for Category C2.

2.6 OPTIONAL FEATURES

A. Multiple-Motor Capability: VFC suitable for variable-speed service to multiple motors. Overload protection shuts down VFC and motors served by it, and generates fault indications when overload protection activates.

1. Configure to allow two or more motors to operate simultaneously at the same speed; separate overload relay for each controlled motor.

B. Damper control circuit with end-of-travel feedback capability.

C. Sleep Function: Senses a minimal deviation of a feedback signal and stops the motor. On an increase in speed-command signal deviation, VFC resumes normal operation.

D. Motor Preheat Function: Preheats motor when idle to prevent moisture accumulation in the motor.

E. Firefighter's Override (Smoke Purge) Input: On a remote contact closure from the firefighter's control station, this password-protected input:

1. Overrides all other local and external inputs (analog/digital, serial communication, and all keypad commands).

2. Forces VFC to operate motor, without any other run or speed command, at a field-adjustable, preset speed.

3. Forces VFC to transfer to bypass mode and operate motor at full speed.

4. Causes display of override mode on the VFC display.

5. Reset VFC to normal operation on removal of override signal automatically.

F. Remote Indicating Circuit Terminals: Mode selection, controller status, and controller fault.

G. Remote digital operator kit.

H. Communication Port: RS-232 port, USB 2.0 port, or equivalent connection capable of connecting a printer and a notebook computer.

2.7 ENCLOSURES

A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.

1. Dry and Clean Indoor Locations: Type 1.

B. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFC as "Plenum Rated."

2.8 ACCESSORIES

A. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

1. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry. Comply with IEEE C57.13.

B. Cooling Fan and Exhaust System: For NEMA 250, Type 1; UL 508 component recognized: Supply fan, with composite intake and exhaust grills and filters; 120-V ac; obtained from integral CPT.

2.9 SOURCE QUALITY CONTROL

A. Testing: Test and inspect VFCs according to requirements in NEMA ICS 61800-2.

1. Test each VFC while connected to a motor that is comparable to that for which the VFC is rated.

2. Verification of Performance: Rate VFCs according to operation of functions and features specified.

B. VFCs will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.

B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Wall-Mounting Controllers: Install with tops at uniform height and with disconnect operating handles not higher than 79 inches (2000 mm) above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."

B. Floor-Mounting Controllers: Install VFCs on 4-inch (100-mm) nominal thickness concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete" or Section 033053 "Miscellaneous Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.

2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

4. Install anchor bolts to elevations required for proper attachment to supported equipment.

C. Roof-Mounting Controllers: Install VFC on roofs with tops at uniform height and with disconnect operating handles not higher than 79 inches (2000 mm) above finished roof surface

unless otherwise indicated, and by bolting units to curbs or mounting on freestanding, lightweight, structural-steel channels bolted to curbs. Seal roof penetrations after raceways are installed.

1. Curbs and roof penetrations are specified in Section 077200 "Roof Accessories."

2. Structural-steel channels are specified in Section 260529 "Hangers and Supports for Electrical Systems."

D. Seismic Bracing: Comply with requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

F. Install fuses in each fusible-switch VFC.

G. Install fuses in control circuits if not factory installed. Comply with requirements in Section 262813 "Fuses."

H. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors are installed.

I. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

J. Comply with NECA 1.

3.3 CONTROL WIRING INSTALLATION

A. Install wiring between VFCs and remote devices and facility's central-control system. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic-control devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switches are in manual-control position.

2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor-overload protectors.

3.4 IDENTIFICATION

A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

2. Label each VFC with engraved nameplate.

3. Label each enclosure-mounted control and pilot device.

B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.5 FIELD QUALITY CONTROL

A. Comply with commissioning requirements in specification section 019113 -General Commissioning Requirements, and specification section 260800 (BA2)

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections with the assistance of a factory-authorized service representative.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

E. Tests and Inspections:

1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.

2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.

3. Test continuity of each circuit.

4. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Owner before starting the motor(s).

5. Test each motor for proper phase rotation.

6. Perform tests according to the Inspection and Test Procedures for Adjustable Speed Drives stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

8. Perform the following infrared (thermographic) scan tests and inspections, and prepare reports:
   a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each VFC. Remove front panels so joints and connections are accessible to portable scanner.
   b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each VFC 11 months after date of Substantial Completion.

c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. VFCs will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

C. Adjust the trip settings of instantaneous-only circuit breakers and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to 6 times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed 8 times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Owner before increasing settings.

D. Set the taps on reduced-voltage autotransformer controllers.

E. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."

F. Set field-adjustable pressure switches.

3.8 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.

B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFCs.

END OF SECTION

SECTION 26 32 13
ENGINE GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes packaged engine-generator sets for emergency standby power supply with the following features:

1. Diesel engine.
2. Unit-mounted cooling system.
3. Unit-mounted and remote-mounted control and monitoring.
4. Performance requirements for sensitive loads.
5. Fuel system.
6. Parallel generator sets.
7. Load banks.

B. Related Requirements:

1. Section 263600 "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.
2. Section 262313 "Paralleling Low-Voltage Switchgear" for controls and paralleling equipment for large or multiple parallel engine generators.
3. **Section 260800 “Electrical Commissioning” for commissioning requirements.**

1.3 DEFINITIONS

A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

B. EPS: Emergency power supply.

C. EPSS: Emergency power supply system.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Include thermal damage curve for generator.
3. Include time-current characteristic curves for generator protective device.
4. Include fuel consumption in gallons per hour at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
5. Include generator efficiency at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
6. Include air flow requirements for cooling and combustion air in cfm at 0.8 power factor, with air supply temperature of 95, 80, 70, and 50 deg F. Provide drawings showing requirements and limitations for location of air intake and exhausts.
7. Include generator characteristics, including, but not limited to kw rating, efficiency, reactances, and short-circuit current capability.

B. Shop Drawings:

1. Include plans and elevations for engine-generator set and other components specified. Indicate access requirements affected by height of subbase fuel tank.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Identify fluid drain ports and clearance requirements for proper fluid drain.
4. Design calculations for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
5. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include base weights.
6. Include diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for EPS equipment and functional relationship between all electrical components.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For engine-generator set, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: With engine and generator mounted on rails identify center of gravity and total weight, external silencer, subbase-mounted fuel tank, and each piece of equipment not integral to the engine-generator set, and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Source quality-control reports, including, but not limited to the following:

1. Certified summary of prototype-unit test report.
2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.

3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
5. Report of sound generation.
6. Report of exhaust emissions showing compliance with applicable regulations.
7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.

C. Field quality-control reports.

D. Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
   a. Operating instructions laminated and mounted adjacent to generator location.
   b. Training plan.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: One for every 10 of each type and rating but no fewer than one of each.
2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.
4. Tools: Each tool listed by part number in operations and maintenance manual.

1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 5 years from date of Substantial Completion or 1,500 hours (Include parts, labor and travel).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

1. Caterpillar; Engine Div.
2. Onan/Cummins Power Generation; Industrial Business Group.

B. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Engine-generator set housing, day tank, engine-generator set, batteries, battery racks, silencers, and sound attenuating equipment, accessories, and components shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Shake-table testing shall comply with ICC-ES AC156. Testing shall be performed with all fluids at worst case normal levels.
3. Component Importance Factor: 1.5.

B. ASME Compliance: Comply with ASME B15.1.

C. NFPA Compliance:

1. Comply with NFPA 37.
2. Comply with NFPA 70.
3. Comply with NFPA 99.
4. Comply with NFPA 110 requirements for Level 1 emergency power supply system.

D. UL Compliance: Comply with UL 2200.

E. Engine Exhaust Emissions: Comply with EPA Tier 2 requirements and applicable state and local government requirements.

F. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: Minus 15 to plus 40 deg C.
2. Relative Humidity: Zero to 95 percent.
3. Altitude: Sea level to 4,800 ft.

G. Commissioning of the equipment’s required for the contractor and vender per specification 019113

2.3 ASSEMBLY DESCRIPTION

A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.

C. EPSS Class: Engine-generator set shall be classified as a Class 2 in accordance with NFPA 110.

D. Induction Method: Turbo Charged-After Cooled

E. Governor: Adjustable isochronous, with speed sensing.

F. Emissions: Comply with EPA Tier 2 requirements.

G. Mounting Frame: Structural steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.

1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

H. Capacities and Characteristics:

1. Power Output Ratings: Nominal ratings as indicated at 0.8 power factor excluding power required for the continued and repeated operation of the unit and auxiliaries.
2. Output Connections: Three-phase, four wire.
3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

I. Generator-Set Performance for Sensitive Loads:

1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.

a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.

2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.
3. Transient Voltage Performance: Not more than 13 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.

5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.
7. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
8. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.

    a. Provide permanent magnet excitation for power source to voltage regulator.

10. Start Time: Comply with NFPA 110, Type 10, system requirements.

J. Parallel Engine Generators:

1. Automatic reactive output power control and load sharing between generator sets operated in parallel.
2. Automatic regulation, automatic connection to a common bus, and automatic synchronization, with manual controls and instruments to monitor and control paralleling functions.
3. Protective relays required for equipment and personnel safety.
4. Paralleling suppressors to protect excitation systems.
5. Reverse power protection.
6. Loss of field protection.

2.4 ENGINE

A. Fuel: Fuel oil, Grade DF-2.

B. Rated Engine Speed: 1800 rpm.

C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm (11.4 m/s).

D. Lubrication System: The following items are mounted on engine or skid:

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

E. Jacket Coolant Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.

F. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.

1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.

    a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.
    b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

G. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

1. Minimum sound attenuation of 25 dB at 500 Hz.
2. Sound level measured at a distance of 25 feet (8 m) from exhaust discharge after installation is complete shall be 75 dBA or less.

H. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

I. Starting System: 24-V electric, with negative ground.

1. Components: Sized so they are not damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Performance Requirements" Article.
2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
3. Cranking Cycle: As required by NFPA 110 for system level specified.
4. Battery: Lead acid, maintenance free, AGM type, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least three times without recharging.
5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to

maintain battery above 10 deg C regardless of external ambient temperature within range specified in "Performance Requirements" Article. Include accessories required to support and fasten batteries in place. Provide ventilation to exhaust battery gases.

7. Battery Stand: Factory-fabricated, two-tier metal with acid-resistant finish designed to hold the quantity of battery cells required and to maintain the arrangement to minimize lengths of battery interconnections.
8. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35 A minimum continuous rating.
9. Battery Charger: Current-limiting, automatic-equalizing and float-charging type designed for lead-acid batteries. Unit shall comply with UL 1236 and include the following features:

    a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
    b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg F (minus 40 deg C) to 140 deg F (plus 60 deg C) to prevent overcharging at high temperatures and undercharging at low temperatures.
    c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
    d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
    e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
    f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.5 DIESEL FUEL-OIL SYSTEM

A. Comply with NFPA 30.

B. Piping: Fuel-oil piping shall be Schedule 40 black steel, complying with requirements in Section 231113 "Facility Fuel-Oil Piping." Cast iron, aluminum, copper, and galvanizing shall not be used in the fuel-oil system.

C. Main Fuel Pump: Mounted on engine to provide primary fuel flow under starting and load conditions.

D. Fuel Filtering: Remove water and contaminants larger than 1 micron.

E. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.

F. Day Tank: Double-Wall, Fuel-Oil Tank: Factory installed and piped, complying with UL 142 fuel-oil tank with integral, float-controlled transfer pump and the following features:

1. Containment: Integral rupture basin with a capacity of 150 percent of nominal capacity of day tank.

    a. Leak Detector: Locate in rupture basin and connect to provide audible and visual alarm in the event of day-tank leak.

2. Tank Capacity: As recommended by engine manufacturer for an uninterrupted period of 4 hours' operation at 100 percent of rated power output of engine-generator system without being refilled.
3. Pump Capacity: Exceeds maximum flow of fuel drawn by engine-mounted fuel supply pump at 110 percent of rated capacity, including fuel returned from engine.
4. Low-Level Alarm Sensor: Liquid-level device operates alarm contacts at 25 percent of normal fuel level.
5. High-Level Alarm Sensor: Liquid-level device operates alarm and redundant fuel shutoff contacts at midpoint between overflow level and 100 percent of normal fuel level.
6. Piping Connections: Factory-installed fuel supply and return lines from tank to engine; local fuel fill, vent line, overflow line; and tank drain line with shutoff valve.
7. Redundant High-Level Fuel Shutoff: Actuated by high-level alarm sensor in day tank to operate a separate motor control device that disconnects day-tank pump motor. Sensor shall signal solenoid valve, located in fuel suction line between fuel storage tank and day tank, to close. Both actions shall remain in shutoff state until manually reset. Shutoff action shall initiate an alarm signal to control panel but shall not shut down engine-generator set.

G. Provide controls and fuel pumps to transport fuel to/from main fuel tank. Provide return pump with floats and controls. Comply with requirements in Section 23 12 13 "Facility Fuel-Oil Pumps."

2.6 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms.

B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms.

C. Provide minimum run time control set for 30 minutes with override only by operation of a remote emergency-stop switch.

D. Comply with UL 508A.

E. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration. Panel shall be powered from the engine-generator set battery.

F. Protective Devices and Controls in Local Control Panel: Shutdown devices and common visual alarm indication as required by NFPA 110 for Level 1 system, including the following:

1. Start-stop switch.
2. Overcrank shutdown device.
3. Overspeed shutdown device.
4. Coolant high-temperature shutdown device.
5. Coolant low-level shutdown device.
6. Low lube oil pressure shutdown device.
7. Overcrank alarm.
8. Overspeed alarm.
9. Coolant high-temperature alarm.
10. Coolant low-temperature alarm.
11. Coolant low-level alarm.
12. Low lube oil pressure alarm.
13. Lamp test.
14. Contacts for local and remote common alarm.
15. Coolant high-temperature prealarm.
16. Generator-voltage adjusting rheostat.
17. Main fuel tank low-level alarm.

    a. Low fuel level alarm shall be initiated when the level falls below that required for operation for the duration required in "Fuel Tank Capacity" Paragraph in "Diesel Fuel-Oil System" Article.

18. Run-Off-Auto switch.
19. Control switch not in automatic position alarm.
20. Low cranking voltage alarm.
21. Battery-charger malfunction alarm.
22. Battery low-voltage alarm.
23. Battery high-voltage alarm.
24. Generator overcurrent protective device not closed alarm.

G. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

H. Connection to Datalink: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication. Provide connections for datalink transmission of

indications to remote data terminals via BacNet MSTP protocol. ~~Data system connections to terminals are covered in Section 260913 "Electrical Power Monitoring and Control."~~

I. Remote Alarm Annunciator: Comply with NFPA 99. An LED labeled with proper alarm conditions shall identify each alarm event, and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.

1. Overcrank alarm.
2. Coolant low-temperature alarm.
3. High engine temperature prealarm.
4. High engine temperature alarm.
5. Low lube oil pressure alarm.
6. Overspeed alarm.
7. Low fuel main tank alarm.
8. Low coolant level alarm.
9. Low cranking voltage alarm.
10. Contacts for local and remote common alarm.
11. Audible-alarm silencing switch.
12. Run-Off-Auto switch.
13. Control switch not in automatic position alarm.
14. Fuel tank low alarm.
15. Fuel tank high-level shutdown of fuel supply alarm.
16. Lamp test.
17. Low cranking voltage alarm.
18. Generator overcurrent protective device not closed.

J. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

K. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation. Mount on exterior of generator enclosure unless otherwise noted in plans.

2.7 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Overcurrent protective devices for the entire EPSS shall be coordinated to optimize selective tripping when a short circuit occurs. Coordination of protective devices shall consider both utility and EPSS as the voltage source.

1. Overcurrent protective devices for the EPSS shall be accessible only to authorized personnel.

B. Generator Circuit Breaker: Molded-case, electronic-trip type; 100 percent rated; complying with UL 489.

1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
2. Trip Settings: Selected to coordinate with generator thermal damage curve.
3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
4. Mounting: Adjacent to or integrated with control and monitoring panel.

C. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector performs the following functions:

1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms. Contacts shall be available for load shed functions.
2. Under single or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the generator set.
4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.

D. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground fault.

1. Indicate ground fault with other generator-set alarm indications.
2. Trip generator protective device on ground fault.

2.8 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H or Class F.

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required. Provide 12 lead alternator.

E. Range: Provide broad range of output voltage by adjusting the excitation level.

F. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

G. Instrument Transformers: Mounted within generator enclosure.

H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified and as required by NFPA 110.
   1. Maintain voltage within 20 percent on one step, full load.
   2. Provide anti-hunt provision to stabilize voltage.
   3. Maintain frequency within 10 percent and stabilize at rated frequency within 5 seconds.

I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

K. Subtransient Reactance: 16 percent, maximum.

2.9 VIBRATION ISOLATION DEVICES

A. As recommend by manufacturer to maintain seismic certification

B. Vibration isolation devices shall not be used to accommodate misalignments or to make bends.

2.10 ENCLOSURE LIGHTING

A. Exterior Enclosures: Provide service lighting with integral battery backup within generator enclosure where packaged generator set is located outdoors.

2.11 FINISHES

A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.12 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

   1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.

B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:

   1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
   2. Test generator, exciter, and voltage regulator as a unit.

3. Full load run.
4. Maximum power.
5. Voltage regulation.
6. Transient and steady-state governing.
7. Single-step load pickup.
8. Safety shutdown.
9. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
10. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

B. Examine roughing-in for piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.

B. Equipment Mounting:

1. Install packaged engine generators on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Coordinate size and location of concrete bases for packaged engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
3. Coordinate size and location of roof curbs, equipment supports, and roof penetrations for remote radiators. These items are specified in Section 077200 "Roof Accessories."

C. Install packaged engine-generator to provide access, without removing connections or accessories, for periodic maintenance.

D. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping and specialties.

B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine-generator to allow service and maintenance.

C. Connect engine exhaust pipe to engine with flexible connector.

D. Connect fuel piping from **adjacent day tank (BA2)** to engines with a gate valve and union and flexible connector. **Day tank provided by division 231113 (BA2)**

1. Diesel storage tanks, tank accessories, piping, valves, and specialties for fuel systems are specified in Section 231113 "Facility Fuel-Oil Piping."

E. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Provide a minimum of one 90 degree bend in flexible conduit routed to the generator set from a stationary element.

3.4 IDENTIFICATION

A. Identify system components according to Section 230553 "Identification for HVAC Piping and Equipment" and Section 260553 "Identification for Electrical Systems."

B. Install a sign indicating the generator neutral is bonded to the main service neutral at the main service location.

3.5 FIELD QUALITY CONTROL

A. Comply with commissioning requirements in specification section 019113 -General Commissioning Requirements, and specification section 260800 (BA2)

B. 260800 Electrical Commissioning (BA2)

C. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

D. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

E. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections.

F. Tests and Inspections:

1. Perform tests recommended by manufacturer and each visual and mechanical inspection and electrical and mechanical test listed in the first two subparagraphs as specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.

   a. Visual and Mechanical Inspection

      1) Compare equipment nameplate data with drawings and specifications.
      2) Inspect physical and mechanical condition.
      3) Inspect anchorage, alignment, and grounding.
      4) Verify the unit is clean.

   b. Electrical and Mechanical Tests

      1) Perform insulation-resistance tests in accordance with IEEE 43.

         a) Machines larger than 200 horsepower (150 kilowatts). Test duration shall be 10 minutes. Calculate polarization index.

      2) Test protective relay devices.
      3) Verify phase rotation, phasing, and synchronized operation as required by the application.
      4) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
      5) Conduct performance test in accordance with NFPA 110.
      6) Verify correct functioning of the governor and regulator.
      7) ***Provide the engineer and commissioning agent with a start up report and completed warranty documents with in one week of start-up.***

2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

   a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
   b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
   c. Verify acceptance of charge for each element of the battery after discharge.
   d. Verify that measurements are within manufacturer's specifications.

4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.

5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
7. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
8. Harmonic-Content Tests: Measure harmonic content of output voltage at 25 percent and 100 percent of rated linear load. Verify that harmonic content is within specified limits.
9. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations 25 feet (7.6 m) from edge of the generator enclosure, and compare measured levels with required values.

G. Coordinate tests with tests for transfer switches and run them concurrently.

H. Test instruments shall have been calibrated within the last 12 months, traceable to NIST Calibration Services, and adequate for making positive observation of test results. Make calibration records available for examination on request.

I. Leak Test: After installation, charge exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.

J. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.

K. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

L. Remove and replace malfunctioning units and reinspect as specified above.

M. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

N. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

END OF SECTION 263213

SECTION 263600
TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. 019113 – GENERAL COMMISIONING REQUIREMENTS

C. 260800 – COMMISIONING ELECTRICAL SYSTEMS

1.2 SUMMARY

A. This Section includes transfer switches rated 600 V and less, including the following:
   1. Automatic Bypass/isolation switches.
   2. Critical Power Management System (CPMS)
   3. Remote Critical Power Management Terminals
   4. Remote Connectivity.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
   1. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Seismic Qualification Certification: Submit certification that transfer switches accessories, and components will withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems." Include the following:
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
      a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
      b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
   1. Features and operating sequences, both automatic and manual.
   2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

B. Provide Engineer and Commissioning Agent with a start-up report and completed warranty documents within one week of start-up.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
   1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

C. Source Limitations: Obtain automatic transfer switches and remote annunciator and control panels through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with commissioning requirements in specification section 019113 - General Commissioning Requirements, and specification section 260800 (BA2)

F. Comply with NEMA ICS 1.

G. Comply with NFPA 70.

H. Comply with NFPA 99.

I. Comply with NFPA 110.

J. Comply with UL 1008 unless requirements of these Specifications are stricter.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:
   1. Notify Construction Manager no fewer than 7 days in advance of proposed interruption of electrical service.
   2. Do not proceed with interruption of electrical service without Construction Manager's written permission.

1.8 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by ASCO.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
   1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.

C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
   1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
   2. Switch Action: Double throw; mechanically held in both directions.
   3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.

G. Neutral Switching. Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles with overlapping neutral contacts.

H. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.

I. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Section 260553 "Identification for Electrical Systems."
   1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
   2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
   3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.

J. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

K. The transfer switch shall have a load shedding circuit for initiated by closing of customer supplied contact. Relay de-energization opens emergency contactor (CE) disconnecting the load from the emergency source. If normal source is acceptable the normal source contactor (CN) is closed to connect the load to the normal source. When load is

reconnected to normal, the control panel is reset in readiness for the next normal source failure. A manual 2 position load shed override toggle switch shall be provided.

L. Transfer Switches which are rated for 1200A or less will not require rear nor side access. Pull boxes are to be included as necessary, per the project drawings.

2.3 CLOSED TRANSITION BYPASS / ISOLATION AUTOMATIC TRANSFER SWITCHES

A. Comply with Level 1 equipment according to NFPA 110.

B. Description: Manual type, arranged to select and connect either source of power directly to load, isolating transfer switch from load and from both power sources. Include the following features for each combined automatic transfer switch and bypass/isolation switch:
   1. Means to lock bypass/isolation switch in the position that isolates transfer switch with an arrangement that permits complete electrical testing of transfer switch while isolated. While isolated, interlocks prevent transfer-switch operation, except for testing or maintenance.
   2. Drawout Arrangement for Transfer Switch: Provide physical separation from live parts and accessibility for testing and maintenance operations.
   3. Bypass/Isolation Switch Current, Voltage, Closing, and Short-Circuit Withstand Ratings: Equal to or greater than those of associated automatic transfer switch, and with same phase arrangement and number of poles.
   4. Contact temperatures of bypass/isolation switches shall not exceed those of automatic transfer-switch contacts when they are carrying rated load.
   5. Operability: Constructed so load bypass and transfer-switch isolation can be performed by 1 person in no more than 2 operations in 15 seconds or less.
   6. Legend: Manufacturer's standard legend for control labels and instruction signs shall describe operating instructions.
   7. Maintainability: Fabricate to allow convenient removal of major components from front without removing other parts or main power conductors.

C. Interconnection of Bypass/Isolation Switches with Automatic Transfer Switches: Factory-installed copper bus bars; plated at connection points and braced for the indicated available short-circuit current.

D. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.

E. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.

F. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.

G. Automatic Closed-Transition Transfer Switches: Connect both sources to load momentarily. Transition is controlled by programming in the automatic transfer-switch controller.

   1. Fully automatic make-before-break operation when transferring between two available power sources.
   2. Load transfer without interruption, through momentary interconnection of both power sources not exceeding 100 ms.
   3. Initiation of No-Interruption Transfer: Controlled by in-phase monitor and sensors confirming both sources are present and acceptable.
      a. Automatic transfer-switch controller takes active control of generator to match frequency, phase angle, and voltage.

b. Controls ensure that closed-transition load transfer closure occurs only when the two sources are within plus or minus 5 electrical degrees maximum, and plus or minus 5 percent maximum voltage difference.

4. Failure of power source serving load initiates automatic break-before-make transfer.

2.4 REMOTE ANNUNCIATOR SYSTEM

A. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches. Annunciation shall include the following:
1. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
2. Switch position.
3. Switch in test mode.
4. Failure of communication link.

B. Annunciator Panel: LED-lamp type with audible signal and silencing switch.
1. Indicating Lights: Grouped for each transfer switch monitored.
2. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.
3. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.
4. Lamp Test: Push-to-test or lamp-test switch on front panel.

2.5 REMOTE ANNUNCIATOR AND CONTROL SYSTEM

A. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches. Annunciation shall include the following:
1. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
2. Switch position.
3. Switch in test mode.
4. Failure of communication link.

2.6 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Section 260548 "Vibration and Seismic Controls for Electrical Systems."

B. Floor-Mounting Switch: Anchor to floor by bolting.
1. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 4 inches (100 mm) in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support. Construct concrete bases according to Section 260529 "Hangers and Supports for Electrical Systems."

C. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.

D. Identify components according to Section 260553 "Identification for Electrical Systems."

E. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.
   2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
   3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
      a. Check for electrical continuity of circuits and for short circuits.
      b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
      c. Verify that manual transfer warnings are properly placed.
      d. Perform manual transfer operation.
   5. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
      a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
      b. Verify time-delay settings.
      c. Verify pickup and dropout voltages by data readout or inspection of control settings.
      d. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
      e. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
      f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
   6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
      a. Verify grounding connections and locations and ratings of sensors.

C. Testing Agency's Tests and Inspections:
   1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
   2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
   a. Check for electrical continuity of circuits and for short circuits.
   b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
   c. Verify that manual transfer warnings are properly placed.
   d. Perform manual transfer operation.

4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
   a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
   b. Simulate loss of phase-to-ground voltage for each phase of normal source.
   c. Verify time-delay settings.
   d. Verify pickup and dropout voltages by data readout or inspection of control settings.
   e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
   f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
   g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
5. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
   a. Verify grounding connections and locations and ratings of sensors.

D. Coordinate tests with tests of generator and run them concurrently.

E. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

F. Remove and replace malfunctioning units and retest as specified above.

G. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
3. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Section 01 79 00 "Demonstration and Training.

B. Coordinate this training with that for generator equipment.

END OF SECTION

SECTION 26 41 13
LIGHTNING PROTECTION FOR STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes lightning protection system for ordinary structures.

B. Section includes lightning protection system for the following:
   1. Ordinary structures.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:
   1. Include layouts of the lightning protection system, with details of the components to be used in the installation.
   2. Include raceway locations needed for the installation of conductors.
   3. Details of air terminals, ground rods, ground rings, conductor supports, splices, and terminations, including concealment requirements.
   4. Include roof attachment details, coordinated with roof installation.
   5. Calculations required by NFPA 780 for bonding of metal bodies.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Lightning protection system Shop Drawings, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Lightning protection cabling attachments to roofing systems and accessories.
   2. Lightning protection strike termination device attachment to roofing systems, coordinated with the roofing system manufacturer.
   3. Lightning protection system components penetrating roofing and moisture protection systems and system components, coordinated with the roofing system manufacturer.

B. Qualification Data: For Installer.

C. Product Certificates: For each type of roof adhesive for attaching the roof-mounted air terminal assemblies, approved by the roofing-material manufacturer.

D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For lightning protection system to include in maintenance manuals.
   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
      a. Dimensioned site plan showing dimensioned route of the ground loop conductor and the ground rod locations. Comply with requirements of Section 017839 "Project Record Documents."
      b. A system testing and inspection record, listing the results of inspections and ground resistance tests, as recommended by NFPA 780, Annex D.

B. Completion Certificate:
   1. LPI Master Certificate.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: LPI Master Installer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

   1. ERICO International Corporation.
   2. Harger Lightning & Grounding.
   3. Heary Bros. Lightning Protection Co. Inc.
   4. Thompson Lightning Protection, Inc.
   5. VFC Lightning Protection, Inc.

2.2 PERFORMANCE REQUIREMENTS

A. NFPA Lightning Protection Standard: Comply with NFPA 780 requirements for Class II buildings.

B. Lightning Protection Components, Devices, and Accessories: Listed and labeled by a qualified testing agency as complying with UL 96, and marked for intended location and application.

2.3 MATERIALS

A. Air Terminals:
   1. Aluminum unless otherwise indicated.
   2. 5/8-inch (16-mm) diameter by 12 inches (305 mm) long.
   3. Rounded tip.
   4. Threaded base support.

B. Class II Main Conductors:
   1. Aluminum: 192,000 circular mils in diameter.

C. Secondary Conductors:
   1. Aluminum: 41,400 circular mils in diameter.

D. Conductor Splices and Connectors: Compression fittings that are installed with hydraulically operated tools, or exothermic welds, approved for use with the class type.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lightning protection components and systems according to NFPA 780.

B. Install conductors with direct paths from air terminals to ground connections. Avoid bends less than 90 degrees and 8 inches (203 mm) in radius and narrow loops.

C. Conceal conductors within normal view from exterior locations at grade within 200 feet (60 m) of building. Comply with requirements for concealed systems in NFPA 780.
   1. Roof penetrations required for down conductors and connections to structural-steel framework shall be made using listed through-roof fitting and connector assemblies with solid rods and appropriate roof flashings. Use materials approved by the roofing manufacturer for the purpose. Conform to the methods and materials required at roofing penetrations of the lightning protection components to ensure compatibility with the roofing specifications and warranty.
   2. Install conduit where necessary to comply with conductor concealment requirements.
   3. Air Terminals on Single-Ply Membrane Roofing: Comply with adhesive manufacturer's written instructions.

D. Ground Ring Electrode: The conductor shall be not less than the main-size lightning conductor.

3.2 CONNECTIONS

A. Aboveground concealed connections, and connections in earth or concrete, shall be done by exothermic welds or by high-compression fittings listed for the purpose.

B. Aboveground exposed connections shall be done using the following types of connectors, listed and labeled for the purpose: high compression.

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.

3.3 CORROSION PROTECTION

A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.

B. Use conductors with protective coatings where conditions would cause deterioration or corrosion of conductors.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
1.
2. Perform inspections to obtain an LPI certification.

B. Prepare test and inspection reports and certificates.

END OF SECTION

SECTION 26 51 19
LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Interior solid-state luminaires that use LED technology.
2. Lighting fixture supports.
3. Standby Emergency Power supplies for individual luminaires

B. Related Requirements:
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 09 36 "Standalone Multipreset Modular Dimming Controls" for architectural dimming systems and for fluorescent dimming controls with dimming ballasts specified in interior lighting Sections.
3. Section 26 09 43 "Relay-Based Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.

1.3 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.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.

3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps and accessories identical to those indicated for the lighting fixture as applied in this Project. Report data compliant with IES LM-79 and IES LM-80. Only Absolute Photometry is acceptable.
   a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products (NVLAP).

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.

C. LEED Submittals:
1. Product Data for Credit IEQ 4.2: For paints and coatings, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4.2: For paints and coatings, documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Samples: For each luminaire and for each color and texture with standard factory-applied finish.

E. Samples for Initial Selection: For each type of luminaire with custom factory-applied finishes.
1. Include Samples of luminaires and accessories involving color and finish selection.

F. Samples for Verification: For each type of luminaire.
1. Include Samples of luminaires and accessories to verify finish selection.

G. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Lighting luminaires.
2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches (300 mm) of the plane of the luminaires.
4. Structural members to which equipment and or luminaires will be attached.
5. Initial access modules for acoustical tile, including size and locations.
6. Items penetrating finished ceiling, including the following:
   a. Other luminaires.
   b. Air outlets and inlets.
   c. Speakers.
   d. Sprinklers.

e. Access panels.
f. Ceiling-mounted projectors.
g.

7. Moldings.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

D. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Product Certificates: For each type of luminaire.

F. Product Test Reports: For each luminaire, for tests performed by manufacturer or a qualified testing agency holding NVLAP accreditation.

G. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
1. Provide a list of all lamp types LED Modules and LED Drivers used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents citing lighting fixture types.
1. Lamps: 2 for every 100 of each type and rating installed. Furnish at least one of each type.
2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

C. Provide luminaires from a single manufacturer for each luminaire type.

D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

E. Mockups: For interior lighting luminaires in room or module mockups, complete with power and control connections.
   1. Obtain Architect's approval of luminaires in mockups before starting installations.
   2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
   3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

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 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

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."

2.2 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. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. Recessed Fixtures: Comply with NEMA LE 4.

E. Bulb shape complying with ANSI C79.1.

F. Lamp base complying with ANSI C81.61 or IEC 60061-1, where employing universal base or mount.

G. CRI of minimum 80. CCT of 3500 K.

H. L70 rated lamp life of 50,000 hours.

I. Lamps dimmable as indicated or 0.5 to 100 percent of maximum light output, via 0-10 VDC control signal or, where indicated, Digital Dimming Control Signal.

J. Field Replaceable driver.

K. Nominal Operating Voltage: Universal voltage 120 V ac or 277 V ac unless scheduled differently.
1. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

L. Housings:
1. Hydroformed, cast or extruded-aluminum housing and heat sink suitable for the environment.
2. Anodized or powder-coat finish.

2.3 LED LAMPS AND DRIVERS:

A. Minimum CRI Ra- 82 or as specified.

B. Lumen output shall be Luminaire Lumens or Delivered Lumens. Source lumens shall not be used.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

D. LED Rated life L70 of 50,000 hours per (IES LM-80). Luminaire shall maintain LED operating temperature to achieve this rating per TM-21.

E. Flicker: No visible or detectable flicker, operating on all dimmed intensities.

F. Dimming drivers shall be compatible with the control method shown on the drawings. All dimmed drivers shall use 0-10vdc control unless specified differently. Minimum level as scheduled.

G. Inrush current shall be reported and the lighting controls adjusted for inrush of LED product supplied.

H. THD: THD shall not exceed 80%.

I. Minimum driver efficiency shall be 83%.

J. LED module shall be replaceable in the field using modules with digitally traceable matching modules.

K. Luminaire shall be NRTL Listed at intended operating temperature.

L. Photometry shall be measured or absolute photometry. Derived or calculated photometry shall not be provided for consideration.

M. Approved Manufacturers- Drivers
1. General Electric.
2. Philips.
3. Osram / Sylvania.
4. Lutron
5. EldoLED
6. Thomas Research

N. Approved Manufacturers- LEDs
1. General Electric
2. Philips
3. Osram
4. Cree
5. Xicato
6. Nichia

O. Approved Manufacturers for Luminaires shall be as scheduled.

2.4 MATERIALS

A. Metal Parts:
1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. 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.

C. Diffusers and Globes:
1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

D. Housings:
1. Hydroformed, cast or extruded-aluminum housing and heat sink suitable for the environment.
2. Anodized or powder-coat finish.

E. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and line wattage. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
1. Label shall include the following lamp characteristics:
   a. "USE ONLY" and include specific lamp type.
   b. Lamp diameter, shape, size, wattage, and coating.
   c. CCT and CRI for all luminaires.

2.5 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.

2.6 LUMINAIRE FIXTURE SUPPORT COMPONENTS

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. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gauge (2.68 mm).

D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

2.7 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

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. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.

C. Comply with NFPA 70 and NFPA 101.

D. Comply with NEMA LE 4 for recessed luminaires.

E. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body and compatible with LED light source and driver, including dimming driver.

1. Emergency Connection: Operate luminaire continuously at an output of 5 watts upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast.
2. Operation: Relay automatically turns driver/led module 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 or exceeding 104 deg F with an average value exceeding 95 deg over a 24-hour period.
    b. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F
    c. Humidity: More than 95 percent (condensing).

d. Altitude: Exceeding 3300 feet

4. Battery: Sealed, maintenance-free, lead-acid type.
5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Supports:
1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and repair.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

D. Flush-Mounted Luminaire Support:
1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

E. Wall-Mounted Luminaire Support:
1. Attached to structural members or approved backer plate in walls
2. Do not attach luminaires directly to gypsum board.

F. Ceiling-Mounted Luminaire Support:
1. Ceiling mount with four 5/32-inch- (4-mm) diameter steel wire or aircraft cable supports.

2. Ceiling mount with hook mount.

G. 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 wire support 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.

H. Ceiling-Grid-Mounted Luminaires:
1. Secure to any required outlet box.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

I. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.5 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.

3.6 STARTUP SERVICE

A. Comply with requirements for startup specified in Section 26 09 43 "Relay-Based Lighting Controls."

3.7 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION

SECTION 27000

GENERAL COMMON CONDITIONS FOR ALL COMMUNICATION SECTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, and other documents as designated, apply to this Document.
B. See Division7 and section 27 01 00 Part 3 for additional requirements.

1.2 RELATED SECTIONS

A. Specifications throughout all Divisions of the Project Manual are directly applicable to this section, and this section is directly applicable to them.
   1. All Division 27 Sections
   2. Requirements of the following Division 26 sections apply to this section.
      a. Basic electrical requirements
      b. Basic electrical materials and methods
      c. Grounding, earthing, and bonding.
   3. Division 21 Fire Suppression
   4. Division 22 Plumbing
   5. Division 23 HVAC
   6. Division 28 Electronic Safety and Security

1.3 SUMMARY

A. The work on many processes in this section is not part of Division 27. The respective trades shall include their portions, and administration topics that are applicable to all Division 27 Sections in their proposals.
B. This document is based upon the 2018 Construction Specification Institute (CSI) Master Format numbers and titles for sections within Division 27: Communications.
C. Where IT or Owner representation is stipulated in this Division, it shall be provided by the Data Center Operations.

1.4 SUBMITTALS

A. Product data shall be supplied for any parts/equipment that do not match the specified part number.
B. Shop drawings
   1. Labeling schedules and layouts in owner designed electronic format.
   2. Cabling administrative drawings

1.5 CONDITIONS

Drawings and General provisions of the contract, including communications section ands, Supplementary General Conditions, architectural plans and specifications, requirements of Division 1, electrical, mechanical, plumbing, audio visual, security, and telecommunications specifications and plans apply to the communications section, and shall be consider a part of this section. The contractor shall read all sections in their entirety and apply them as appropriate for work in this section.

A. Prior to beginning installation, a kick-off meeting to properly coordinate the tray installation and expectations should be held. It should be arranged by the General Contractor, and at a minimum include representatives of the following trades: FP&D, Electrical (Div. 26), Structured cable, Nurse Call, paging, building automation and control,

plumbing, HVAC, fire sprinkler, framing, and others as applicable. The Data Center Operations Infrastructure Cabling Team will lead the meeting.

B. Conflicts:
   1. Drawings and specifications are to be used in conjunction with one another and to supplement one another. In general, the drawings determine the nature and quality of the installation, materials, and tests. The quantities are derived from the drawings, details, listings, and manufacturer's directions.
      a. Final order counts and distances are the contractor's responsibility.
   2. If there is an apparent conflict between the drawings and specifications, or between specification sections, the items with the greater quality or quantity shall be submitted, estimated, and installed.
   3. Clarification with the Owner and/or Owner's Representative about these items shall be made prior to the ordering and installation.

C. Owner / Contractor
   1. The Architect/Project Manager will submit appropriate scope of work information that will allow the contractor to appropriately plan and bid the project.

D. Contractor
   1. Furnish all labor, materials, tools, equipment, and services for the installation described herein. Provide add/deduct unit pricing for all components as part of the bid response. Base fixed price add/deduct units on an average cable length of 175 linear feet.
   2. The Contractor shall procure and maintain for the duration of this agreement insurance against claims.
   3. Use of Subcontractors: Successful bidder shall inform the Owner's contact and/or General Contractor in writing about the intention to use Subcontractors and the scope of work for which they are being hired. The Owner or Owner's designated contact must approve the chosen Subcontractors in writing prior to the Subcontractor's hiring and start of any work. The low voltage Subcontractor must be approved and certified. Refer to the listing in appendix 7.
   4. Use of Subcontractors: The Contractor's designated project manager will be recognized as the single point of contact. The Project manager shall oversee all work performed to ensure compliance with specifications as outlined in bid documents (which include all specifications and drawings) to ensure a quality installation.

1.6 SCOPE OF WORK

A. This establishes a communications infrastructure to be used as signal pathways for voice, high-speed data transmission, and other low voltage services. Contractor shall:
   1. Comply with all Master Specifications documents and the following requirements for a complete project installation.
   2. Provide a structured cabling system as described hereafter that includes, but is not limited to, supplying, installing, labeling and testing of fiber backbone, fiber and voice riser cable; data copper, fiber, and voice copper horizontal cabling, cable connectors, communications outlets and terminations, patch cables, and equipment racks/cabinets for networking hardware and patch panels.
   3. All requirements and specifications will be enforced. Cable pathways and runs to individual outlets are not shown in their entirety but should be provided as if shown in their entirety.
   4. Coordinating with electrical tradespersons to verify conduit routing does not cause cabling to exceed allowable 295' link length.
   5. Follow industry standard installation procedures, including BICSI Installation Standard and guidelines as well as specified manufacturers standard recommended procedures and installation practices for communications cable to ensure that the mechanical and electrical transmission characteristics of this cable plant and equipment are maintained.
   6. Division 27 work shall be performed by an approved, certified installer.

7. The low voltage communications Subcontractor shall complete non-concealed work.

1.7 **REFERENCE STANDARDS**

A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
B. All reference amendments adopted prior to the effective date of the Contract shall be applicable to this Project.
C. The publications listed below form a part of this specification. The publications are referred to in the text by basic designation only.
D. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean reference to the latest printed edition of each in effect at the date of contract.
E. Codes and Standards (Most recent editions with addenda/TSB, etc.) All materials, installation and workmanship shall meet or exceed the applicable requirements and standards addressed within the references listed in **Appendix 04**.

1.8 **DEFINITIONS**

A. Definitions and Abbreviations are listed in **Appendix 05**:

PART 2 - PRODUCTS

2.1 **PRODUCTS AND WORK NOT included BY DIVISION 27**

A. Others shall separately purchase and/or provide certain equipment and miscellaneous items that will be installed during the installation process. Such items may not be indicated in the documents. Contractor shall coordinate with the Owner and his suppliers when considering:
1. Provision and installation of phone systems, computer hardware, and related networking software and equipment.
2. Provision and installation of multi-port routers, hubs in communications rooms.
a. TEC/TDR UPSs are owner provided, and contractor installed.
3. Communications grounding bus bars and grounding wires connecting to the main building electrode system by Division 26.
4. Dedicated power panels, ground bus bars, circuits, and utility outlets.
5. Installation and finishing of fire-rated plywood backboards.
6. Building mechanical ductwork, cooling/heating system, and environmental control sensors.
7. Communication pathway devices such as conduits, conduit sleeves, back boxes, and penetrations in walls and floors. Including, but not limited to concealed work, office spaces and open areas.
8. Provision and installation of modular furniture and millwork.

PART 3 – PENETRATIONS

3.1 **THE WORK IN THIS SECTION IS IN DIVISION 7 CONTRACT; AND VERIFIED COMPLETE AT PROJECT TURNOVER.**

B. Wall Penetrations - Fire - Smoke – Sound
1. All fire, smoke, and sound wall penetrations must be correctly done to protect the safety of patients and employees. A facility is designed/architected and built with fire integrity that must not be lost as the building is modified over its lifetime.
2. The items listed often penetrate 1 – and 2 – hour fire-resistance-rated (FRR) assemblies. General requirements for filling the space between the item in question and the wall are found in NFPC 101® Section 8.2.3.2.4.2. There is the option to either fill the space with appropriately rated fire-stop material or protect the space with an approved device designed to maintain the fire resistance of the wall. (Preferred method)

3. If a sleeve is used around the item that transverses the wall, the sleeve must be installed into the wall without any opening between the sleeve and the wall. The open space within the sleeve must then be filled with appropriately rated fire stop material.

C. All items listed in 1 through 2 must have penetrations in fire-resistance-rated assemblies filled to maintain the integrity of the fire barrier.
   1. Conduits
      a. When conduit passes through a wall that is either rated or must be fire-stopped due to lack of sprinklers in the compartment, it is essential to fill any gap around the conduit as described above.
   2. Cables/Wires
      a. Sometimes cables or wires are passed through a penetration contained in a fire wall as a single installation. This often happens in a health care organization with communication cables. Even in these cases, the penetration must be patched appropriately.
   3. NOTE: Fire, smoke, and sound wall penetration are also governed by local and state building codes.
   4. NOTE: This requirement applies to all departments, organizations, employees, and/or vendors who perform structured cable work in the facilities for:
      a. Telephony and Computer networks, fire, smoke, and sound wall penetrations, alarm systems, security systems, HVAC Control or sensors, patient entertainment systems, announcing systems, nurse call, telemetry, RFID, etc.
   5. NOTE: While this document is written specifically for low voltage wiring, the JCAHO standards apply for any fire or smoke wall penetration. As you perform work in the facility, if you note any existing penetrations that are not up to standard, please notify the construction Project Manager immediately.
   6. While Facility Engineering has the overall responsibility, each department, organization, employee, and/or vendor has the responsibility to follow the process in obtaining a permit from facility engineering before work is started and to follow the guidelines to maintain the fire/smoke wall integrity.

D. Process:
   1. NOTE: This process applies to any person, group, and/or vendor who performs low voltage cable installations at any Intermountain facility or clinic.
      a. Fire/Smoke Walls
         1) Any Vendor, department, and/or person needing to do any cable work that involves wall penetrations, adding to existing or new, are required to obtain a “Above Ceiling Permit” from Facility Engineer.
      b. Above Ceiling Work
         1) Any vendor, department, and/or person needing to do any cable work above ceiling tiles, adding to existing or new, are required

            to obtain an “Above Ceiling Permit, ICRA Permit and any other required permits.
      c. Above Ceiling Permit to be obtained from Facilities Management
         1) The permit requires detailed information as to what work is being done, and where the work will be done. The permit will also state the current approved sealing compound for the facility and specific requirements for conduits etc.
         2) There may also be specific rules regarding how work may be conducted in certain areas of the hospital. NOTE: Different manufacturers’ sealing products can NOT be used in the same penetration. Therefore, if an additional cable is added to an existing penetration, and you don’t have the same brand of caulk, you must remove all the caulk and re-do the seal completely.
      d. ICRA Permit to be obtained from Infectious Preventionist
      e. Hot Work Permit to be obtained from Facilities Engineer
   2. Quality of Work
      a. Facility Engineering Orientation

2.2 **MEASUREMENT PROCEDURES**

A. The Contractor shall
1. Coordinate supports, adjacent construction, and fixture locations to ensure actual dimensions correspond to established dimensions.
2. Verify dimensions in areas of installation by field measurements before fabrication and indicate measurements and scale on shop drawings.
3. Coordinate fabrication schedule with construction progress to avoid delaying the work.
4. Where field measurements cannot be made without delaying the work, establish dimensions and coordinate with the General Contractor.
5. When approved, proceed with fabricating units without field measurements.

2.3 **CHANGES**

A. ALTERNATES:
1. If an alternate material is proposed that is equal to or exceeds specified requirements, Contractor shall provide manufacturers' specifications in writing for Owner approval prior to purchase and installation.
2. Substitutions of material by the Contractor shall be in writing complete with written manufacturers' specifications. The material substituted shall not void, alter or change manufacturers' structured cabling system warranty.
3. Contractor shall:
   a. Provide a complete cabling infrastructure according to these written specifications and drawings. If the Owner changes the scope of work to be performed by the Contractor, it shall be in writing.
   b. Promptly respond to these changes with a complete material list, including pricing, and labor in writing, presented to the Owner for approval. Also include unit pricing.
   c. Do not proceed with any additional scope of work without a signed approval by the Owner.
4. Owner will not pay for additional work performed by the Contractor without signed approval of these changes. The contractor will submit a copy of the signed change order upon billing.
5. The Owner's Infrastructure Cable team will be the final judge of acceptability, with review by Owner's Representative and the distribution of the acceptance by the Architect. No substitute shall be ordered, installed, or utilized without the Architect's prior written verification of acceptance from the Owner's Infrastructure Cable team.

B. SUBSTITUTION PROCEDURES
1. Substitution may be considered when a product becomes unavailable through no fault of the Contractor.
2. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Include in each request for substitution:
   a. Product identification, manufacturer's name and address.
   b. Product Data: Description, performance and test data, reference standards, finishes and colors.
   c. Samples: Finishes
   d. Complete and accurate drawings indicating construction revisions required (if any) to accommodate substitutions.
   e. Data relating to changes required in construction schedule.
   f. Cost comparison between specified and proposed substitution.
3. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.
4. The Owner will be the final judge of acceptability, with review by the Owner's Representative and the distribution of the acceptance by the Architect.

5. No substitute shall be ordered, installed or utilized without the Architect's prior written verification of acceptance from the Owner's Infrastructure Cable team.

PART 3 - EXECUTION

3.1 **QUALITY ASSURANCE**

A. Regulatory Requirements:
   1. Contractors shall supply all city, county, and state telecommunication cabling permits required by appropriate governing agency.
   2. Prior to commencing work, the Contractor and staff shall secure all required Intermountain Health permits including, but not limited to; facility sign in, ceiling work permits, hot work permits, and confined space permits.
   3. Contractors shall be city, county, and state-licensed and/or bonded as required for communications/low voltage cabling systems work.

B. Certifications:
   1. Contractor shall submit an up-to-date and valid certification verifying qualifications of the Contractor and installers to perform the work specified herein at time of bid submission.
   2. The contractor shall have a complete working knowledge of low voltage cabling applications such as, but not limited to data, voice and video network systems.
   3. The contracting firm shall have installed similar-sized systems in at least ten (10) other projects in the last five years prior to this bid and be regularly engaged in the business of installation of the types of systems specified in this document. Certification shall include, but not be limited to, items such as name and location of project contacts and numbers, total square footage, total number of cables/drops, types of media, etc.
   4. Contractors shall provide certificates for the appropriate insurance coverage as defined in contract documents.
   5. All installation personnel that will be assigned to this project shall be listed in a qualification document. 50% of the personnel working on the job site shall have a
   6. minimum of 3 years' experience in the installation of the types of systems, equipment, and cables specified in this document. Any personnel substitutions shall be noted in writing to Owner's Data Center Operations Infrastructure
      Cabling representative prior to commencement of work.
   7. BICSI ITS Cabling Installation Program Installer Level 1 or 2 or Technician certifications may be substituted in lieu of the 3-year requirement. All cabling installers shall be trained and certified by the cable manufacturer for communication cabling installations and maintenance of said materials.
   8. Refer also to General Conditions.

C. Administrative Requirements and Coordination:
   1. The Contractor shall:
      a. Ensure that all technicians performing work have obtained badge access 48 hours prior to scheduled start.
      b. Provide a specified contact person (name and contact number) for coordination to attend project meetings with the communication consultant, the Owner, and others.
      c. Coordinate work of this section with Owner's system specifications, workstations, equipment suppliers, and installers.
      d. Coordinate installation work with other crafts (examples include ceiling grid contractors, HVAC and sheet metal contractors, etc.) under the direction of the General Contractor to resolve procedures and installation placement for cable trays and cable bundle pathways. The goal of this coordination will be to establish priority pathways for critical data/voice network cable infrastructure, materials, associated hardware, as well as mitigate delays to the project and to allow service access for communications and HVAC components. Damage by Contractor to the craftwork of others will be remediated at the Contractor's expense in a timely manner.

e. Exchange information and agree on details of equipment arrangements and installation interfaces. Record agreements reached in meetings and distributed records to other participants, Owner and communication consultant.

f. Arrangement, layout, and locations of distribution frames, patch panels, and cross-connect blocks in equipment rooms and racks to accommodate and optimize arrangement and space requirements of any service provider equipment, telephone system, and LAN equipment as directed by Data Center Operations. Tasks shall be coordinated with the Owner's Data Center Operations team, and other trades' installation representatives.

g. Where installed, confirm exact locations and method of mounting outlets in modular furniture. Follow furniture manufacturers' written instructions for installing cable and devices in modular partitions. Obtain modular furniture and power pole locations from the General Contractor. Wiring locations noted in plans along walls for modular furniture are approximate and will have to be determined by Contractor at time of installation. Field condition adjustments for installation may have to be made and coordination efforts with the mechanical and electrical contractor for pathway must take place early in the project to comply with maximum 40% conduit fill factor requirements.

h. When requested by Owner or Owner's representative, furnish extra materials that match specified products and that are factory packaged with protective covering for storage and identified with labels describing contents. Unit pricing shall apply.

D. Contract Administration:

1. Change orders shall be submitted to the Owner/Project Manager complete with price breakdown and description for approval before any work is done.
2. Owner's Data Center Operations Representative will provide job field reports upon inspection of Contractor's installation, materials, supporting hardware, coordination with other trades and progress to schedule to the Owner's project manager.
3. Job Field Report outline:
   a. General installation progress in relation to scheduled work made by the Contractor up to that date.
   b. All deficiencies noted in the cable installation need to be corrected by the Contractor.

E. Pre-Installation Meetings - Contractor shall:

1. Attend and/or arrange a scheduled pre-installation conference prior to beginning any work of this section.
   a. Agenda: This venue is to ask and clarify questions in writing related to work to be performed, scheduling, coordination, etc. with consultant and/or project manager/and Data Center Operations Infrastructure Cabling representative.
   b. Attendance: Communications project manager/supervisor shall attend meetings arranged by General Contractor, Owner's Data Center Operations Infrastructure Cabling representatives, and other parties affected by the work of this document.
   c. All individuals who will be installers of communication cables and equipment in an on-site supervisory capacity shall be required to attend the pre-installation conference. Individuals who do not attend the conference will not be permitted to supervise the installation of, or install, terminate, or test communications cables on the project. This includes supervisors, project managers, and lead installers of this project.

F. Request for Change (RFC)

1. A Request for Change shall be opened and approved by the Change Approval Board prior to any modifications, attachments, or other activities that may affect production systems.

a. Policy and details available through the Data Center Operations Infrastructure Cable Representative.

G. Post-Installation Meetings:
1. Schedule Div. 27 Final Inspection
2. At the time of substantial completion, or shortly thereafter, the low voltage Sub-Contractor shall call and arrange for a post-installation meeting to present and review all submittal documents to include, but not limited to as-built drawings, test reports, warranty documentation, etc. Attendees shall be Owner staff, Owner's Representative, General Contractor, and others that the General Contractor deems appropriate.
3. At this meeting the Contractor shall present and explain all documentation, including test results, and ask for feedback on its completeness. Any discrepancies or deviations noted by and agreed to by participants shall be remedied by the Contractor and resubmitted within one week of the meeting.

3.2 DELIVERY, STORAGE, AND HANDLING

A. Coordination with delivery companies, drivers, site address, and contact person(s) will be the responsibility of the Contractor.
B. Contractor Shall:
1. Be responsible for prompt material deliveries to meet the contracted completion date.
2. Coordinate deliveries and submittals with the General Contractor to ensure a timely installation.
3. No equipment materials shall be delivered to the job site more than three weeks prior to the commencement of its installation.
4. Equipment shall be delivered in original packages with intact labels and clearly marked identification.
5. Materials shall not be damaged in any way and shall comply with the manufacturer's operating specifications.
6. Equipment and components shall be protected from the weather, humidity, temperature variations, dirt, dust, or other contaminants. Equipment damaged prior to system acceptance shall be replaced at no cost to the Owner.
7. Material Contractor shall be responsible for all handling and control of equipment. Material Contractor is liable for any material loss due to delivery and storage problems.
C. The owner/General Contractor shall supply a list of security requirements for the Contractor to follow.

3.3 PROJECT/SITE CONDITIONS

A. For all environmental recommendations, refer to the master Architectural section.
B. For all security recommendations, refer to related Division 01.
C. After completing system installation, including outlet fittings and devices, inspect exposed finish. Contractors will remove burrs, dirt, and construction debris. If applicable, the Contractor will repair damaged finishes, including chips, scratches, and abrasions.
D. The contractor shall provide daily a clean work environment, free from trash/rubbish accumulated during and after cabling installation.
E. Food and drink are not permitted in work areas. They shall be stored, prepared, and consumed only in designated break or cafeteria areas.
F. The contractor shall keep all liquids (drinks, sodas, etc.) off finished floors, carpets, and tiles. If any liquid or other detriment (cuts, soils, stains, etc.) damages the above finishes, Contractor shall provide professional services to clean or repair scratched/soiled finishes, at Contractor's expense.

3.4 CLEANING

A. Work areas will be kept in a broom clean condition throughout the duration of the installation process.

B. Remove all unnecessary tools and equipment, unused materials, packing materials, and debris from each area where work has been performed daily, unless designated for storage.

C. The Contractor will damp clean all surfaces prior to final acceptance by the Owner.

END OF SECTION

SECTION 270100

OPERATION AND MAINTENANCE OF COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 INTRODUCTION

A. To make the approval of such a large topic possible, the structured cable topic has been broken into its subcomponents and each subcomponent was completed, reviewed, and approved in turn. The result is this comprehensive guideline that should provide adequate guidance on this topic.

PART 2 - PRODUCT

2.1 KEY POINTS

A. Category 6A shielded foil over unshielded twisted pair (F/UTP) is the only approved standard for cabling.
   1. Specifically, Siemon category CAT6A F/UTP (foil over unshielded twisted pair) cable and associated patch panels, wall plates and jacks; for all Intermountain health properties.
   2. Only Siemon certified contractors or certified Intermountain Health cable technicians will install structured cable at Intermountain Health facilities.

2.2 IMPLEMENTATION

A. This guide is to be used for New Construction and Remodels. These standards will be implemented over time in existing cabling environments as rework is performed.

B. If there is a current need to connect servers at 10GBaseT and the only option is copper, CAT6A F/UTP is required. New Server connections shall be a minimum OS1 Single Mode Fiber.

C. Installations already in place do not require removing or replacing existing cabling CAT5e or newer. All new cabling shall follow the recommendation to use CAT6A F/UTP cabling.

2.3 STANDARD PRODUCT

A. The Approved cable type for horizontal cabling is CAT 6A F/UTP.
   1. The Approved Standard Manufacturer for Intermountain Health's horizontal cabling is:
      a. **Siemon Company USA**
         101 Siemon Company Drive
         Watertown, CT 06795
   2. Approved Suppliers of Siemon cable, patch panels, jacks, and parts are listed in Appendix 06:

PART 3 - EXECUTION

3.1 HORIZONTAL CABLING

A. Horizontal Subsystem is the portion of the cabling system that extends from (and includes) the work area telecommunications outlet/connector to the Floor Distributor (FD)/Horizontal Cross-connect (HC) in the telecommunications room (TDR). It consists of the communications outlet/connector, the horizontal cable, optional consolidation point,

and that portion of the cross-connect in the telecommunications room serving the horizontal cable. Each floor of a building should be served by its own Floor Distributor/Horizontal (FD/HC) Subsystem located in the Telecommunications Room (TDR).

1. NOTE: Cable installers have rigorous requirements to be certified for Siemon cables and products. Validation of certification is required prior to accepting a bid.
2. Current Siemon Approved/Certified Cable Installers for Siemon Network are listed in Appendix 07.

B. Reliability of the horizontal cabling system is critical to the operation of IS equipment throughout a facility. Installing the cable is extremely labor intensive and there are several learned skills used to correctly install the cable. Cable installers are certified, and installers must demonstrate the ability to install the cable correctly to be certified. If the cable is installed by a certified installer and is installed in accordance with the manufacturer's guidelines, the manufacturer will warranty the cable installation.

C. The manufacturer also requires the cables to be individually labeled and 100% tested and certified. Cable testing and certification equipment is usually expensive and is not commonly available at the facility or by many telecom installers. Certified Installer companies are required by the manufacturer to be knowledgeable in the use of "Qualified" Field Testing equipment and provide test results for warranty registration.

1. The contractor is to verify with the manufacturer the current "Qualified" tester manufacturers and the current operating software.
2. Contractors will provide test results in the operating software format (not PDF, text or Word) to Intermountain Health upon completion.

D. Much of the cable is installed in walls and in the ceiling and usually lasts the lifespan of the building. As with most technology, the lifespan of cable is its usability and applicability to its use on future computing technology.

END OF SECTION

SECTION 270113

WARRANTY, PRODUCT AND SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them, including but not limited to the listing found in Section 27 00 00.

PART 2 - PRODUCTS

2.1 STANDARD WARRANTY

A. Contractor shall provide a minimum one (1) year warranty on installation and workmanship PLUS an Extended Product Warranty and System Assurance Warranty for this wiring system and shall commit to make available local support for the product and system during the Warranty period.
B. System Certification: Upon successful completion of the installation and subsequent inspection, the customer shall be provided with a Manufacture Warranty certificate.
C. Either a permanent link or channel model configuration may be applied to the horizontal and/or backbone sub-systems of the structured cabling system. Applications assurance is only applied to a channel model configuration. All channels are to be qualified for linear transmission performance up to 500 MHz to ensure that high-frequency voltage phase and magnitude contributions do not prove cumulative or adversely affect channel performance.

2.2 EXTENDED WARRANTY

A. The manufacturer of passive telecommunications equipment used in a manner not associated with the Systems Warranty must have a minimum five (5) year Component Warranty on all its products. The Products Warranty covers the components against defects in material or workmanship under normal and proper use.
   1. Special Project Warranty: A full end-to-end written warranty mutually executed by manufacturer and the principal Installer, agreeing to replace and install voice/data distribution system components that fail in materials or workmanship, or do not meet manufacturer's official published specifications and performance criteria within the special Project warranty period specified below. This shall cover applications assurance, cable, and connecting hardware including both labor and materials. This warranty shall be in addition to, and not a limitation of, other rights and remedies the Owner may have against the Contractor under the Contract Documents.
B. A twenty-five (25) year warranty available for the Category 6A Z-MAX copper structured cabling system shall be provided for an end-to-end channel model installation which covers applications assurance, cable, connecting hardware and the labor cost for the repair or replacement thereof. The fiber warranty will be an XGLO twenty (25) year warranty, which is based on using laser optimized single mode fiber as minimum.
   1. Performance claims based on worst case testing and channel configurations.
   2. Special Project Warranty Period: 25 years minimum, beginning on the date of Substantial Completion.
   3. Siemon Certified Warranty Requirements:

a. Upon Completion of the project, Intermountain Health must receive the Full Warranty Documentation from The Siemon Company before final retention funds are released to the general contractor, electrical contractor and structured cabling subcontractor if applicable.

2.3 **MAINTENANCE**

A. Support Availability: The Contractor shall commit to making available local support for the product and system during the Warranty or Extended Warranty period.

END OF SECTION

SECTION 270119

FIELD TESTING AND REPORTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them, including but not limited to the listing found in Section 27 00 00.

1.2 SYSTEM DESCRIPTION

A. The owner reserves the right to be present during any or all testing.
B. The objective of this project is to provide a complete communications cabling infrastructure system installation including, but not limited to fiber backbone, riser system, horizontal data and voice cabling with associated terminations, mounting equipment, cable pathway and management systems, testing and other items/materials, as specified in drawings, these specifications, and contract documents.
C. The Contractor's BICSI Registered Communications Distribution Designer (RCDD) supervisor shall review, approve and stamp all documents prior to submitting. The Contractor's RCDD shall warrant in writing that 100% of the installation meets the requirements specified herein upon completion of all work.
D. Product Certificates shall be signed by manufacturers of cables, connectors, and terminal equipment certifying that products furnished comply with requirements.
E. The contractor shall submit the required Field Test Reports in the format and media specified, upon completion of testing the installed system.
F. Contractor shall deliver manufacturer's signed long-term Warranty of installed cabling system to include all components that comprise the complete cabling system. Delivery to be affected within two weeks of the time of final punch list review. Failure of any component to pass system component tests shall be promptly corrected, repaired or replaced to meet standards compliance.

1.3 PREFERRED OWNER INSPECTION & TEST CHECKPOINTS

A. DCO & ICT Inspection Milestones & Responsibilities need to be coordinated into master project plan to allow the GC to make timely arrangements. All are per floor and/or phase.
    1. ICT & DCO = Framing, during and/or after boxes & conduits are in place, prior to sheetrock.
    2. ICT = When cable basket is starting to be installed.
    3. ICT = When cable basket is ready, but prior to starting to pull cable.
    4. ICT & DCO = When TDRs are ready for racks and ladders.
    5. DCO = When anchoring racks and laying out equipment.
    6. ICT & DCO = When TDR environmental requirements are ready, the room is dust free, and securable. See attached TDR checklist.
        a. The TEC and TDRs must be high on the build timeline and be completed early in the construction to accommodate the building systems to be tested and commissioned, such as BAS, Security, and Wireless Network.
    7. ICT = When trim and testing are in progress.
    8. OTHERS
        a. Depending on the project, the manufacturer will inspect 1 or 2 times.
        b. DCO or ICT = When problems or questions arise.

PART 2 - PRODUCTS

2.1 SITE TESTS & INSPECTIONS

A. Prior to pulling the cable, the cabling contractor shall schedule an inspection of the pathways with a member of the Data Center Operations Infrastructure cabling team.

B. Upon completion of the communications infrastructure systems, including all pathways and grounding, the Contractor shall test the system.
   1. Cables and termination modules shall be affixed, mounted or installed to the designed/specified permanent location prior to testing.
   2. Any removal and reinstallation of any component in a circuit, including faceplates, shall require retesting of that circuit and any other disturbed or affected circuits.
   3. Approved instruments, apparatus, services, and qualified personnel shall be utilized.
   4. If tests fail, Contractor shall correct as required to produce a legitimate passing test.
   5. Manipulation of tester parameters on a failing test to achieve a passing test is unacceptable.

C. These specifications will be strictly enforced. The Contractor must verify that the requirements of the specifications are fully met through testing with an approved tester (rated for testing the cable type in use), and documentation as specified below. This includes confirmation of requirements by demonstration, testing and inspection. Demonstration shall be provided at the final walk-through in soft copy.

D. Notification of the likelihood of a cable exceeding standardized lengths must be made prior to installation of the cable. Without the contractor's prior written notice and written approval by the Owner, testing that shows some or all pairs of cable not meeting specifications, shall be replaced at Contractor's expense (including respective connectors).

E. Testing is still required for non-compliant cabling. The tests shall be for wire-mapping, opens, cable-pair shorts, and shorts-to-ground. The test results must be within acceptable tolerances and shall be submitted with the Owner's acceptance document.

2.2 CABLE TESTING PLAN

A. The Contractor shall:
   1. Provide a complete and detailed test plan for approval of the cabling system specified herein, including a complete list of test equipment for copper and fiber optic components and accessories prior to beginning cable testing. The following minimal items shall be submitted for review:
      a. All testing methods that clearly describe procedures and methods.
      b. Product data for test equipment
      c. Certifications and qualifications of all persons conducting the testing.
      d. Calibration certificates indicate that equipment calibration meets National Institute of Standards and Technology (NIST) standards and has been calibrated at least once in the previous year of the testing date.
   2. Include validation, and testing. Owner will require that the telecommunications cabling system installed by the Contractor be fully certified to meet all necessary requirements to be compliant with referenced IEEE and TIA specifications and vendor's warranty.
   3. Will determine the source/cause of test failure readings and correct malfunctioning component and/or workmanship within each channel or permanent link and retest to demonstrate compliance until corrected failure produces a passing result.

2.3 CABLE TESTING REPORTS

A. The Contractor shall submit cable test reports as follows:
   1. Submit certified test reports of Contractor-performed tests.
      a. The tests shall clearly demonstrate that the media and its components fully comply with the requirements specified herein.

b. (1) set of electronic test reports shall be submitted and clearly identified with cable identification.

PART 3 - EXECUTION

3.1 TEST EQUIPMENT

A. All transmission testing of balanced twisted-pair cables shall be performed with an approved Level III balance twisted pair tester found on the Siemon Ally Website. The latest version of software shall be installed prior to performing testing. Refer to the Siemon Warranty Documents for proper testing requirements of associated cable and components.

B. All balanced twisted-pair field testers shall be factory calibrated each calendar year by the field test equipment manufacturer as stipulated by the manuals provided with the field test unit. The calibration certificate shall be provided for review prior to the start of testing

C. Auto test settings provided in the field tester for testing the installed cabling shall be set to the default parameters

D. Test settings selected from options provided in the field testers shall be compatible with the installed cable under test.

3.2 TEST METHOD / CRITERIA

A. Copper Testing

1. Testing of all newly installed cable channels shall be performed prior to system cutover.
   a. Visually inspect F/UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments and inspect cabling connections for compliance with TIA/EIA-568-C.1.
   b. Visually confirm Category 6A marking of outlets, cover plates, outlet/connectors, and patch panels.
   c. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
   d. Test F/UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
   e. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-C, and those required by manufacturer to validate and start warranty.
2. Copper Testing all 500 MHz category 6A field-testing shall be performed with an approved level 111e balanced twisted-pair field test device, that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex (Level IIe or IIIe balanced twisted pair field test device). Use only test cords and adapters that are qualified by test equipment manufacturers for channel or link test configuration.
3. All installed 500 MHz category 6A channels shall perform equal to or better than the minimum requirements as specified below:
   a. Category 3 balanced twisted-pair backbone cables, for the channel shall be 100 percent tested according to ANSI/TIA/EIA-568-C.1. Test parameters include wire map plus F/UTP (ScTP) shield continuity (when present), insertion loss, length and NEXT loss (pair-to-pair). NEXT testing shall be done in both directions.
   b. 500 MHZ Category 6A balanced twisted-pair horizontal and backbone cables, shall be 100 percent tested.
4. F/UTP Performance Tests
   a. Wire map.
   b. Length (physical vs. electrical, and length requirements)
   c. Insertion loss

d. Near-end crosstalk (NEXT) loss
e. Power sum near-end crosstalk (PSNEXT) loss
f. Equal-level far-end crosstalk (ELFEXT)
g. Power sum equal-level far-end crosstalk (PSELFEXT)
h. Return loss
i. Propagation delay
j. Delay skew
k. F/UTP Shield continuity

5. Final Verification Tests: Perform verification tests for F/UTP systems after the complete communications cabling and workstation outlet/connectors are installed.
6. Document data for each measurement. Data for submittals shall be printed in a summary report.
7. End-to-end cabling will be considered defective if it does not pass tests and inspections.
8. Prepare and submit test and inspection reports.

B. Horizontal Fiber Testing
1. Fiber horizontal cables shall be 100% tested for insertion loss and length.
2. Insertion loss shall be tested at 850 nm or 1300 nm for 50/125µm and 62.5/125µm multimode cabling in at least one direction using the Method B (1-jumper) test procedure as specified in ANSI/TIA/EIA-526-14A.
3. Length shall be tested using an OTDR, optical length test measurement device or sequential cable measurement markings.
4. The horizontal link performance guarantees are based on an optical fiber calculation for the appropriate fiber solution. Optical fiber calculations shall be determined using the Siemon Fiber Loss Calculator found on the Siemon Ally Website.

C. Backbone Fiber Testing
1. Fiber backbone cables shall be 100% tested for insertion loss.
2. Insertion loss shall be tested at both 850 nm and 1300 nm for 50/125µm and 62.5/125µm multimode cabling and both1310 nm and 1550 nm for 8.5/125µm single mode cabling and in at least one direction using the Method B (1-jumper) test procedure as specified in ANSI/TIA/EIA-526-14A.
3. Insertion loss shall be tested at 1310 and 1550 for single-mode cabling in at least one direction using the Method A.1 (1-jumper) test procedure as specified in ANSI/TIA/EIA-526-7.
4. Length shall be tested using an OTDR, optical length test measurement device or sequential cable measurement markings.
5. The backbone link performance guarantees are based on an optical fiber calculation for the appropriate fiber solution. Optical fiber calculations for any fiber cable greater than 90m (295 ft.) shall be determined using the Siemon Fiber Loss Calculator found on the Siemon Ally Website.

3.3 DEMONSTRATION

A. Include training for appropriate IT staff in numbering system and documentation system methods and record keeping. Proper fiber terminations and fiber jumper installations.

END OF SECTION

SECTION 270133

SHOP DRAWINGS, PRODUCT DATA, SAMPLES
DESIGN RECORDS & EXISTING CONDITIONS

PART 1 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

1.1 SUBMITTALS

A. The Contractor:
   1. Shall not perform any portion of the work requiring submittal and review of shop drawings, product data, or samples until Owner has approved the respective submittal. Such work shall be in accordance with approved submittals.
      a. Shop drawings as required by the owner or as a minimum to include a minimum of two sets of a plan view and elevations of all work to be installed. The Contractor shall make any corrections required by the owner or the owner's representative or consultant team, file with him two corrected copies and furnish such other copies as may be needed. The consultant's approval of such drawings or schedules shall not relieve the Contractor from responsibility for deviations from drawings or specifications, unless he has in writing and called to the Architect's attention such deviations at the time of submission, nor shall it relieve him from responsibility for errors of any sort in shop drawings or schedules.

B. The Contractor shall provide a copy of the Certified Test Data Sheet, available from the delivering distribution warehouse for either a full run or cut piece from the Master Reel of the fiber cable to be installed
   1. The Certified Test Data Sheet shall include the Master Reel number, cable description, a passing test result with details, test equipment description, date certified, and a certificate of compliance stamp, and shall be included in the O&M Manual as a component of the final deliverables submittal package.

1.2 DRAWINGS

A. Shop Drawings
   1. The Contractor shall:
      a. Submit catalogue cut sheets that include manufacturer, trade name, and complete model number for each product specified. Model number shall be handwritten, marked with an arrow or underlined to indicate exact selection.
      b. Identify applicable specification section reference for each product performance for each component specified for approval prior to purchase and installation.

B. Record Drawings
   1. Drawings for the cabling system infrastructure elements shall be maintained and kept on file by the Siemon Certified Installer (Company) for the entire term of the warranty. Drawings shall include:
      a. Horizontal cable routing and terminations
      b. Telecommunications outlets/connectors
      c. Backbone cable routing and terminations
      d. Telecommunication Spaces (TS)

C. Samples
   1. For workstation outlet connectors, jack assemblies, housing and faceplates for color selection and evaluation of technical specifications and requirements. Confirm with Architect, interior designer, and Owner representative for color
   before purchasing materials. Face plates shall match the electrical face plates in Color and material type.

2. Upon request, provide samples for workstation outlets, jacks, jack assemblies, in specified finish, one for each size and outlet configuration
3. Sample mock-up rooms may be required in some areas to ensure proper equipment placement and fit.

D. Qualifications:
1. The Contractor shall provide the appropriate documentation to comply with the requirements set forth in Section 01 43 23 Qualifications, included with, and at the time of, bid submittal.

PART 2 - SUSTAINABLE DESIGN RECORDS AND REPORTS

2.1 DRAWINGS

A. Closeout Submittals (As-built Drawings):
1. Communications Design drawings are to be supplied to the Architect to prepare the master "As-Built" drawings.
2. As-Built drawings shall be in a format that is compatible with the format used by the Architect and consultant. Dimensions and scale of the drawing sheets submitted shall match the size of the drawing used for the contract documents and shall include the cable numbers labeled in accordance with this document.
3. Utilize normal recognized drafting procedures that match standards, Architect and consultant guidelines and methodology.
4. The As-Built drawings shall incorporate all changes made to the building identified in, but not limited to, addendum, change notices, site instructions or deviations resulting from site conditions.

B. Contractor shall:
1. Clearly identify any resubmitted drawing sheets, documents or cut sheets either by using a color to highlight or cloud around resubmitted information.
2. Maintain drawing numbering or page/sheet scheme consistency as per previously issued drawings/documents.
3. Provide dimensioned plan and elevation views of networking components, showing:
   a. All communications data/voice outlet locations complete with outlet/cable labeling.
   b. Cable routing paths of communications cables to identified infrastructure pathways.
   c. All rack and cabinet locations and labeling thereof.
   d. One-line diagram of equipment/device interconnecting data/voice cabling of the data and voice systems.
   e. Standard or typical installation details of installations unique to Owner's requirements.
   f. Graphic symbols and component identification on detail drawing shall conform to the latest ANSI/TIA 568-C, ANSI/TIA 569-B, ANSI/TIA 606-A and ANSI/NECA/BICSI 607-A conventions.
4. Submit one soft (compatible with Microsoft software) and hard copy with project deliverables within three weeks after substantial completion.
5. Hard copy of floor plans for record shall be plotted to a standard, saleable, identified drawing scale.

2.2 RECORDS AND REPORTS

A. All records shall be created by the installation contractor and turned over at the completion of work.

1. The format shall be computer based
   a. Soft copies and hard copies shall be part of the As-built package.
   b. The minimum requirements include:
      1) Cable records must contain the identifier, cable type, termination

positions at both ends, splice information as well as any damaged pairs/conductors.

2) Connecting hardware and connecting hardware position records must contain the identifier, type, damaged position numbers, and references to the cable identifier attached to it.

2. Test documentation on all cable types shall be included as part of the As-built package.

B. All Siemon Warranty Registration documents shall be included.

C. All reports shall be generated from the computer-based program used to create the records above. These reports should include but not limited to:
1. Cable Reports
2. Cross-connect Reports
3. Connecting Hardware Reports

PART 3 - EXISTING CONDITIONS SITE SURVEY

3.1 SITE SURVEY

A. Prior to placing any cable pathways or cable, the contractor shall survey the site to determine job conditions will not impose any obstructions that would interfere with the safe and satisfactory placement of the cables. The arrangements to remove any obstructions with the Project Manager need to be determined at that time.

END OF SECTION

SECTION 270143

QUALIFICATIONS AND REQUIRED TRAINING FOR CONTRACTORS AND INSTALLERS

PART 1 - GENERAL INSTALLLER QUALIFICATIONS

1.1 **ENTITIES**

A. Communications contractors
   1. The Communications Contractor shall at a minimum possess the following qualifications:
      a. The contractor shall be a Siemon Certified Contractor with valid up to date contract certification and in good standing with the Siemon Company.
      b. Be in business for a minimum of five (5) years.
      c. The contractor shall demonstrate satisfaction of sound financial condition and can be adequately bonded and insured if the project deems necessary.
      d. Possess those licenses/permits required to perform telecommunications installations in the specified jurisdiction.
      e. Use personnel knowledgeable in local, state, province and national codes and regulations. All work shall comply with the latest revision of the codes or regulations. When conflict exists between local or national codes or regulations, the most stringent codes or regulations shall be followed.
   2. Contractors must possess current liability and workers compensation insurance certificates.
   3. Contractors must be registered with BICSI and have at least one RCDD on staff or ITS Cabling Installer Program Technician certification and Installer Level 1 & 2 for a minimum of 75 percent of staff.

1.2 **TRAINING**

A. The Contractor shall be fully conversant and capable in the cabling of low voltage applications such as, but not limited to data, voice and imaging network systems. The Contractor shall at a minimum possess the following qualifications:
   1. Personnel trained and certified in the design of the Siemon Cabling System®.
   2. Personnel trained and certified to install the Siemon Cabling System®.
   3. The Designer and Installer shall show proof of the current certification of the Siemon Cabling System® via an updated certificate given after attending the Certified Installer training course or an on-line re-certification class given every two years.
   4. Provide references for the type of installation provided in this specification.
   5. Personnel trained and certified in the installation of copper cable and in the use of Level IIIe Copper Transmission Performance testers, fiber optic cabling, splicing, termination and testing techniques. Personnel must have experience using an optical light source and power meter plus an OTDR.
   6. Personnel trained in the installation of pathways and supports for housing horizontal and backbone cabling.
B. Facilities Orientation
   1. Personnel must complete the onsite Facilities Orientation

END OF SECTION

SECTION 270171

RESPONSIBILITY AND WORKMANSHIP OF CONTRACTOR

PART 1 - GENERAL

1.1 **CONTRACTOR RESPONSIBILITY**

A. The contractor shall be obligated to exercise the highest standard of care in performing its obligations as defined in a request for proposal. All work shall be done in a workman like fashion of the highest standards in the telecommunications industry.
B. All equipment and materials are to be installed in a neat and secure manner, while cables are to be properly dressed in accordance with standards recommendation for a specific type of media (i.e. UTP vs. F/UTP @ 10 Gigabit)
C. Workers must clean any debris and trash at the close of each job and workday.
D. Contractor acknowledges that Intermountain Health will rely on contractor's expertise, ability and knowledge of the system being proposed and shall be obligated to exercise the highest standard of care in performing contractual obligation as defined in the Scope of Work.
E. Contractor must submit The Siemon warranty, Cable Records, As Built Drawings and Test Results at the completion of work. Note: Intermountain Health reserves the right to withhold final payments until all registration documents are approved by the Siemon Company and received by Intermountain Health.

1.2 **CONTRACTOR AND EMPLOYEE RESPONSIBILITY**

A. Contractors, their employees, and installers will attend annually Intermountain Health required Infection Control training.
B. Contractors, their employees, and installers will complete Symplr registration.
C. Contractors, their employees, and installers will attend Intermountain Health required site and job specific orientation.
D. Contractors, their employees, and installers will maintain Intermountain Health required immunizations.
E. Contractors, their employees, and installers will keep their Intermountain Health required confidentiality agreements current.
F. Contractors, their employees, and installers always agree to follow all Intermountain Health Policies and procedures and wear the appropriate ID while on any Intermountain properties.
G. The contractor will determine with the Owner the appropriate level of Environmental Containment precautions to utilize for each work location. Infection Control Risk Assessments and permits will be performed as required.
H. Upon request, provide qualification data for all qualified layout technicians, installation supervisors, and field inspectors.
    1. Siemon issued qualification badges shall be readily available for this purpose.

1.3 **EXAMINATION**

A. Field Measurements: Verify dimensions in areas of installation by field measurements before fabrication and indicate measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work.
B. Established Dimensions: Where field measurements cannot be made without delaying the work, establish dimensions and proceed with fabricating units without field measurements measurements. Coordinate supports, adjacent construction, and fixture locations to ensure actual dimensions correspond to established dimensions.

1.4 **PREPARATION**

A. Pre-installation inspection

1. The Contractor shall visually inspect all cables, cable reels, and shipping cartons to detect possible cable damage incurred during shipping and transport. Visibly damaged goods are not acceptable and shall be replaced by the contractor at no additional cost to the Owner.

1.5 **MISCELLANEOUS CONTRACTOR RESPONSIBILITIES**

A. Contractors will maintain unobstructed egress in work areas.
B. The contractor will keep access for all Emergency Services.
C. Contractor will maintain training for Personnel in alternate exits if needed.
D. Contractor will maintain Temporary construction partitions, as required, that are smoke tight and built of non-combustible materials.
E. Additional Fire Extinguishers may be required and will be properly maintained and inspected.
F. The construction site will be maintained clean and orderly.
G. The contractor will observe Intermountain Health's Tobacco Use Policy. (All forms of tobacco use are strictly prohibited)
H. All Electrical Extension cords will be grounded, and in good condition and plugged into approved GFI Receptacles.
I. Construction sites will be restricted. (Approved personnel Only)
J. Personal Protective Equipment (PPE) will be worn as required. (i.e. hard hats, safety glasses, safety shoes, fluorescent vest, in accordance with the general contractor's safety policy)
K. Tools will be unplugged, and power secured at the end of each working day.
L. All employees and contractors will understand how to obtain MSDS sheets.
M. The contractor will notify proper personnel of any fire system shut down. A 48-hour notification is required.
N. The contractor will address all vibration concerns to Intermountain Health and the general contractor's staff.
O. The contractor will address all Noise Issues with Intermountain Health and the general contractor's staff.
P. The contractor will fill out a Hot Work permit and keep it on site daily as needed.
Q. The contractor will fill out an Above Ceiling Work Permit and keep it on site daily as needed.
R. The contractor will complete an Infection Prevention permit and will not begin work until it is approved.
S. Contractors will obtain a Confined Space Permit, when required, and keep it on site.
T. The contractor shall notify Information Systems 72 hours in advance of any shutdown or known interruption of required environmental services. Follow up by notifying the Service Desk.
U. Demolition of low voltage cabling shall be performed by the Low Voltage installation contractor.
    1. To prevent accidental removal of in-use circuits.
    2. To allow for re-use of circuits where practical.
V. Prior to removal of unused low voltage cabling, you must verify that both ends of the cable are no longer attached to any device. (Both ends of the cable are un-terminated).

END OF SECTION

SECTION 270500

COMMON WORK RESULTS FOR COMMUNICATONS

PART 1 - PRODUCT

1.1 SUMMARY

A. This section covers general work results for all Communications Division detail subsections.
B. Work of the following sections cover a complete installation of both permanent and channel links for a data and voice communications network utilizing copper and fiber transmission media.

PART 2 - EXECUTION

2.1 SCOPE OF WORK

A. Includes, but is not limited to the following.
   1. The Contractor shall:
      a. Provide and install fabric and/or either plenum, PE or PVC Innerduct, rated appropriately for the installation environment; in accordance with all applicable codes and ordinances.
      b. Provide, install, terminate, test, label and document all fiber backbone, fiber and copper riser cable.
      c. Provide, install, terminate, test, and document all fiber, copper voice, and data horizontal cable.
         1) CAT6A UTP and CAT6A F/UTP shall not be mixed on the same campus.
      d. Provide and place all termination devices such as, but not limited to, modular patch panels, blank panels, termination blocks, information outlets (jacks and plates), phone jacks, fiber distribution panels, bulkheads, connectors, and fiber fan out kits.
      e. Provide in quantities specified interconnect components such as, but not limited to, copper patch cords, fiber patch cables.
      f. Provide and place horizontal and vertical cable support devices such as, but not limited to, rack and wall-mounted horizontal and vertical cable management, cable runway, communications cable runway, and all required mounting hardware, unless otherwise noted.
      g. Provide and install all equipment mounting racks, cabinets and/or brackets.
      h. Provide and install UL-approved fire stopping systems in all communication pass-thru, conduits, cable trays and ceiling, wall and floor penetrations in coordination with General Contractor.
      i. Provide all appropriate consumable items required to complete the installation.
      j. Grounding and bonding in TEC and TR rooms to grounding bus provided by Division 26.
      k. Provide complete documentation and demonstration of work.
      l. Completion of all punch list deficiencies within 10 working days.
      m. Provide indexed and organized complete Test Results of all copper and fiber cable and their components.
      n. Provide Submittals.

o. Conduct a final document handover meeting with client, consultant, and PM to review, discuss and educate the Owner on the test results and As-Built Drawings.
p. Provide a Manufacturer's Extended Product Warranty and System Assurance Warranty for this wiring system.

END OF SECTION

SECTION 270526

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. This work shall be provided by Division 26.
   1. Division 26 shall provide and install the communications system grounding bus bar.
   2. Systems other than the voice/data system shall be bonded by their respective installers or Division 26.
B. Exception: Division 27 shall bond racks, ladders, and other conductive IT equipment and enclosures as required.
C. Requirements of the following Division 26 Sections apply to this section:
   1. Basic Electrical Requirements
   2. Basic Electrical Materials and Methods
   3. Grounding and Bonding for Electrical Systems

1.2 SUMMARY

A. This Section includes methods and materials for grounding and bonding Communications systems.
B. All grounding / earthing and bonding shall be done to applicable codes and regulations. It is recommended that the requirements of IEC/TR 61000-5-2: 1.0, ANSI-J-STD-607-A, or both be observed throughout the entire cabling system.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
   1. Stranded conductors No. 6 AWG.

2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
B. Compression fitting – 2-hole strap.

PART 3 - EXECUTION

3.1 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 (NEC), Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
B. Comply with UL 467 for grounding and bonding materials and equipment.

3.2 APPLICATIONS

A. Conductors: Install stranded conductors for No. 6 AWG and larger, unless otherwise indicated.

3.3 **INSTALLATION**

A. Grounding Conductors
   1. Route along shortest and straightest paths possible, unless otherwise indicated or required by Code.
   2. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
      a. Jumper across all tray junctions use two-hole crimp lugs with a bolt, lock washer and nut to prevent loosening of ground connections over time.
      b. Contractor to remove small area of powder coat or paint to create a metal-to-metal bonding connection.
      c. Per current BICSI TDMM "Grounding, Bonding and Electrical Protection":
         1) Grounding and bonding connectors should be one of the following: Tin plated copper, copper or copper alloy
         2) Connections should be made using crimp connectors, or exothermic welding.
      d. Per TIA/EIA 607-A the TBB (Telecommunications Bonding Backbone) connections "shall be made using irreversible compression-type connectors, exothermic welding or equivalent."

END OF SECTION

SECTION 270528

PATHWAYS FOR COMMUNICATONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Main pathways for communications systems shall be the responsibility of the Division 27 low voltage contract.
   1. Includes, but is not limited to, hangars, supports, J-hooks and cable tray.
   2. Sections 270536 and 270543_46 are supplemental clarifications that are additions to this section. The appropriate section(s) shall be added for the material used.

B. Conduits, pathways, and boxes which are embedded within building finishes for communications systems shall be the responsibility of the Division 26 electrical contractor.

C. Requirements of the following Division 26 sections apply to this section.
   1. Basic electrical requirements
   2. Basic electrical materials and methods
   3. Grounding, earthing, and bonding for electrical systems.

1.2 SUMMARY

A. Contractors shall install work following specifications, drawings, manufacturer's instructions, and approved submittal data.

PART 2 - PRODUCTS

2.1 CABLE PATHWAYS

A. Comply with TIA/EIA-569-B.

B. Pathways shall be designed and installed to meet applicable local and national building and electrical codes or regulations.
   1. All materials shall be UL- and/or CSA and/or ETL-approved and labeled in accordance with NEC for all products where labeling service normally applies.
   2. NRTL labeled for support of Category 6A cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
   3. Materials and equipment requiring UL 94, 149 or 1863 listing shall be so labeled. Modification of products that nullify UL labels is not permitted.
   4. The installed systems shall not generate, nor be susceptible to any harmful electromagnetic emission, radiation, or induction that degrades, or obstructs any equipment.

C. Pathways consist of fire rated sleeves, conduit, basket tray/ladder rack, J-hooks, surface mounted raceway and power poles.
   1. Basket trays shall be utilized for distribution pathways.
      a. Provides proper support and load distribution along pathways.
      b. All wall penetration for the basket tray shall be framed.
      c. Flexibility, scalability, and accessibility.
      d. Ladder rack shall be used in all TEC and TDR's.
   2. Conduits may be utilized where basket tray is not viable, providing the cross-sectional area of the conduit is greater than the cross-sectional area of the basket tray.
   3. Fire Rated Sleeves must be used in place of conduit when penetrating a fire rated wall.
      a. 2" x 2" for room penetrations, 4" x4" for j-hook pathways
      b. Approved Manufacturers
         1) STI EZ Path
         2) Hilti Modular Sleeve

4. J-hooks are the minimum pathway device required for all low voltage contractors for use in ceiling distribution.
   a. Refer to section 270529.

   Note: Surface mounted raceway and power poles should be installed only when other pathway choices are not feasible.

D. Outdoor Microduct
   1. Manufactures
      a. Duraline
      b. Pre-Approved Equal
   2. Description: 7 Way MicroDuct
      a. All Microduct shall be composed of all dielectric materials (except for armored version). All Microduct shall be manufactured to include enhanced jetting design, such as internal ribbing to minimize surface contact and permanent slick interior to eliminate the need for jetting lubricant.
      b. 12.7mm OD1MM ID
      c. Microduct rating FP (OSP)
      d. 7-Way
      e. Color: Orange

2.2 EQUIPMENT

A. Compatibility
   1. All material and equipment as provided should be the standard Commercial-Off-The-Shelf (COTS) products of a manufacturer engaged in the manufacturing of such products. All shall be typical commercial designs that comply with the requirements specified. All material and equipment shall be readily available through manufacturers and/or distributors.
      a. All equipment shall be standard catalogued items of the manufacturer and shall be supplied completely with any optional items required for proper installation.
      b. Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections for optimum future performance and backward compatibility

B. Horizontal cables shall be installed in “clean, dry” locations that provide protection from moisture levels above the intended operating range of inside plant (ISP) cables.
   1. Cable pathways shall be installed to provide protection from the elements (i.e., moisture) and other hazards.
   2. Cables and cable pathways shall be protected from detritus elements such as paints, adhesives, water, and cleaners.
      a. In case of contamination, the cables shall be replaced at General Contractors’ expense. Cleaning is not acceptable.
   3. Pathways shall not have exposed sharp edges that may meet telecommunications cables.

C. Pathways shall not be in elevator shafts.

D. Grounding / Earthing and bonding of pathways shall comply with applicable codes and regulations. It is recommended that the requirements of IEC/TR3 61000-5-2 - Ed. 1.0, ANSI-J-STD-607-B, or both be observed throughout the entire cabling system.

2.3 SURFACE MOUNTING

A. Surface Mount Cable Runs and Faceplate Boxes
   1. Surface mounting of cable pathway runs and/or boxes for outlets/faceplates are only authorized as a last resort and exception to running cables through the wall and above the ceiling.
   2. If surface mount cable runs are used:
      a. Burs will be removed from the inside of the plastic or metal surface mount pathway to prevent damage to cables pulled through the run.

b. Raceway manufacturer plastic bushings shall be installed at all outlet openings in raceway to prevent damage to cable.

c. "T", Splice, and corner pieces will be used to join runs. Runs will not be butted together without the appropriate joining pieces.

PART 3 - EXECUTION

3.1 **HORIZONTAL PARAMETERS**

A. Allowable Cable Bend Radius and Pull Tension:

1. In general, communications cables cannot tolerate sharp bends or excessive pull tension during installation.

a. Bend radius for 4 pair UTP and F/UTP under no load (no pulling tension) shall not exceed four (4) times the outside diameter of the cable and eight (8) times the outside diameter of the cable under load (110N/25lbf). Note: Cable bend radius and pulling tensions for cables other than 4 pair cable increase with the diameter and type of cable refer to the manufacturer's recommendations for specific requirements.

2. After installation, exposed cable and other surfaces must be cleaned free of lubricant residue. Use only lubricants specifically designed for cable installation.

B. Pull Strings:

1. Horizontal and Vertical Pathways

a. The pathway installer shall:

1) Provide pull strings in all new conduits, including all conduits with cable installed as part of this contract.

2) Provide pull strings in all new cable trays.

3) Pull string shall have a rated average breaking strength of 200 pounds.

4) During pulling sessions, pull strings must move freely to prevent cable jacket/cable damage.

5) Free moving pull strings shall be provided in all locations where they are utilized as part of this contract.

C. Conduit Fill:

1. Reference manufacturer's Design Installation Guidelines manual.

2. Comply with requirements of NFPA 70 (NEC)

3. The number of cables placed in a pathway shall not exceed manufacture specifications, nor will the geometric shape of a cable be affected.

a. Conduit pathways shall have a maximum fill ratio of 40% to allow for proper pulling tension and laying of the CAT6A F/UTP cable. A minimum of a 1" diameter conduit is required for new construction. Existing conduits will require the reduction of the number of cables placed in the conduit to meet the required fill ratio.

3.2 **INTRA-BUILDING CABLE ROUTING**

A. Pathways

1. The backbone subsystem shall include cable installed in a vertical manner between floor telecommunications rooms and the main or intermediate cross-connect in a multi-story building and cable installed horizontally between Telecommunications rooms and the main or intermediate cross-connect in a long single-story building.

2. Adequate riser sleeve/slot space shall be available with the ability to ingress the area later in all telecommunications rooms, such that no drilling of additional sleeves/slots is necessary. Proper fire stopping is required for all sleeves/slots per national and local codes. Install fire stop material designed specifically for the building construction conditions and to meet the existing fire stop material as directed by the building engineer.

3. Backbone pathways shall be installed or selected such that the minimum bend radius of backbone cables is kept within manufacturer specifications both during and after installation.
4. Where redundant paths are required, they shall be separated by a minimum of 24".
   a. Separate innerducts and/or armored fiber are required for each leg of the redundant path.
   b. Separate physical routes for each path shall be utilized where possible.
5. Building backbone cables shall be installed in "dry" locations that provide protection from moisture levels above the intended operating range of inside plant (ISP) cables.
6. "Slab-on-Grade" building designs wherein pathways are installed underground on/in the poured concrete slabs that are in direct contact with the soil are considered wet locations and hence are not permitted.

END OF SECTION

SECTION 270529

HANGERS AND SUPPORTS FOR COMMUNICATION SYSTEMS

PART 1 - PRODUCTS

1.1 APPROVED PRODUCT

A. The J-hooks shall meet or exceed the below characteristics of construction and features
   1. Provide broad based support for cabling to aid in maintaining overall system performance.
   2. Be available in 50.8mm (2") and 101.6mm (4") options
   3. Come equipped with a cable retention clip
   4. Offers a full line of mounting accessories.

1.2 APPROVED MANUFACTURERS

A. Ericson / Caddy
B. B-Line
C. Stiffy

PART 2 - EXECUTION

2.1 J-HOOKS AND OTHER SUPPORTS SHALL BE INSTALLED SUCH THAT THEY

A. Shall be supported with devices designed for this purpose and shall be installed independently of any other structural component. J-Hooks shall not use the suspended ceiling support wires or lighting fixture support wires.
B. The number of cables placed into the J-hooks shall be limited to a number that will not cause a change to the geometric shape of the cables.
   1. Limit to a 40% fill in new construction.
C. J-hooks shall not be spaced farther than 1.5 meters (5 ft.) apart, with a recommendation that they be space at 1 meter (3 ft.) apart. Note: Construction may require distances to exceed the maximum and are considered an exception requiring approval of project manager or building engineer.
D. J-hooks or better must be installed without exception.
E. All J-hooks that pass through a fire rated wall must have an EZ-Path Sleeve or Hilti Modular Sleeve installed to go through the fire wall. Size is to be based on J-hook size. To be installed by the Low Voltage Contractor installing the J-hooks.

2.2 UNACCEPTABLE INSTALLATIONS

A. Free flight of cables
B. Resting or attaching of cables on pipes, conduits, HVAC duct work, fire sprinkler systems, basket tray, basket tray supports or on the ceiling tiles/grid.

END OF SECTION

SECTION 270533

CONDUITS AND BACK BOXES FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Division 26 – Electrical work

PART 2 - PRODUCTS

2.1 APPROVED PRODUCT

A. Conduits and Back boxes shall meet the construction requirements of the NEC for the type of structure and space in which they are installed and will be of the diameter and size to provide adequate fill, bend radius and connector space. Refer to section 270528.

PART 3 - EXECUTION

3.1 CONDUIT SIZING

A. Conduit size shall be based on the type of cable installed and the required fill ratio and bend radius associated with the type of cable specified.
   1. Minimum conduit size to back box for CAT6A F/UTP shall be 1-inch EMT.

Conduit Trade Size (metric designator)	Max number of cables based upon allowable fill		
	Cable O.D.		
	7.4mm (0.29 in.)	8.4mm (0.33 in.)	8.9mm (0.35 in.)
1 (27)	4	3	2
1-1/4 (35)	6	5	4
1-1/2 (41)	9	7	6
2 (53)	14	11	10
2-1/2 (63)	20	16	14
3 (78)	31	24	22
3-1/2 (91)	42	32	29
4 (100)	54	42	37

B. Conduit and installation shall be provided by Division 26.
C. All conduit stubs shall be installed with plastic bushings appropriate for the size of conduit used.
D. Conduits that stub to accessible ceiling shall be installed in the direction to provide the shortest path to the TDR, complete with pull string.
E. Conduit pathway must be provided to the nearest basket tray when area has hard lid or decorative ceiling.

3.2 BACK BOX SIZING

A. New work back boxes for CAT6A F/UTP shall be a minimum of trade size 4-11/16" x 4-11/16" x 3" (depth) plus a 5/8" plaster ring to allow for proper bend radius and connector termination/installation. Side knockouts shall be avoided.

B. Back boxes for rework shall meet the same specification as for new work.

1. If existing back boxes or back boxes that are smaller due to construction restrictions, then devices such as extension rings, bezels or faceplates shall be used to modify the back box to insure proper bend radius and connector termination/installation.

a. Verification and approval of the size change must have DCO Infrastructure Cabling and engineering approval.

3.3 BACK BOX COMPOSITION

A. All back boxes for IT systems shall be UL/CSA listed and approved for the purpose.

1. Non-metal back boxes shall not be used for any interior IT related device.

3.4 SPECIAL CONDITIONS – LEAD LINED WALLS FOR RADIATION CONTROL

A. Refer to the complete IT Lead Lined Wall Procedure – Attachment Appendix 8

END OF SECTION

SECTION 270536

CABLE TRAY FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. This section shall be coordinated with Sections 270528, and 270543_46

1.2 COORDINATION

A. Prior to beginning installation, a kick-off meeting to properly coordinate the tray installation and expectations should be held. It should be arranged by the General Contractor, and at a minimum include representatives of the following trades: FP&D, Electrical (Div 26), Structured cable, Nurse Call, paging, building automation and control, plumbing, HVAC, fire sprinkler, framing, and others as applicable.

B. The wire basket tray routing shall be approved and installed by the low voltage CI cable contractor (Div. 27 sub-contractor), and Data Center Operation Team.

C. Where adequate space is available a 4", Triple tier J-Hook pathway shall parallel the basket trays for other services
   1. The triple tier J-Hooks shall be installed by the cable tray installer.

D. Single J-Hooks as needed to extend beyond the triple tier, shall be installed by the trade that will be utilizing them.

E. The cable tray shall be a high priority installation to allow adequate time for proper and complete cable installation prior to ceiling grid.

PART 2 - PRODUCTS

2.1 APPROVED PRODUCT

A. The Cable Ladder Tray shall meet or exceed the characteristics of construction and features below:
   1. It shall be fully welded and available in a galvanized silver or powder coat black finish
   2. Have an optional construction using "elongated" shaped wires offering a more broad-based support for installed cables.
   3. The Cable ladder tray shall be used in data rooms for horizontal management above the racks.
   4. Ladder shall match the manufacturer of the data racks or exact equal.
   5. Ladder shall be assembled with manufacturer approved parts and methods.
   6. Ladder Rack must be installed using waterfalls.

2.2 PART NUMBERS (SUBMITTAL REQUIRED)

A. Cable Ladder Tray
   1. Refer to Appendix 3 or the plans for part numbers.

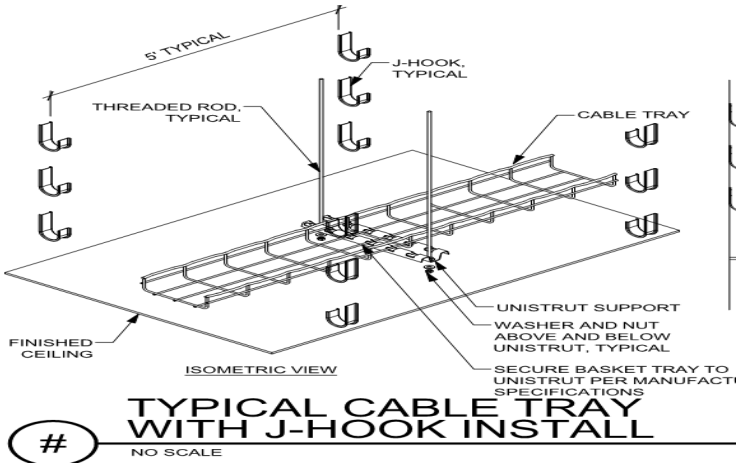
B. APPROVED BASKET TRAY MANUFACTURES
   1. WBT – Wire Basket Ray (preferred).
   2. Siemon RoutelT TM Wire Mesh Cable Tray, or equal basket type tray.
   3. Cabolfil per owner's approval.

PART 3 - EXECUTION

3.1 **PATHWAY INSTALLATION**

A. Supports
1. Installed per Manufacturer's Specifications and utilize components specific to the maintenance of proper access in and out of the basket tray using bend delimiters.
2. Distance between supports shall not exceed 5 feet
   a. Less distance between supports required if per manufacturer's instructions.
   b. Minimum of one support required within 24" on each side of any junction point.
3. Supports shall be of the trapeze design to provide maximum stability.
   a. Each support shall attach to structure via its own hangers.
      1) All hanger supports shall be constructed of rigid material such as all-thread.
      2) All hangers and supports shall be installed perpendicular and plumb to the tray. No angle supports shall be permitted unless augmented perpendicularly.
      3) Vibration and sway (seismic) damping is required.
      4) Provide support across the width of tray underneath, not via basket side wires.
      5) Building walls do not qualify as support and shall not be used as support.
      6) All basket tray penetrations through a wall are to be framed by the General Contractor.
4. Support shall be of sufficient strength to support at least 200% of the expected load
5. Wall mounted angle brackets shall not be used as a load bearing support for basket tray.
6. Basket Tray should not be installed directly below any pressurized water pipes.

B. Complete system access
1. Basket trays shall have a dedicated free clearance zone surrounding it.
   a. 12" clear space shall be provided on the side where natural feed will occur.
   b. 6" clear space shall be provided on the side opposite the feed access.
   c. 8" clear space above the top of tray minimum – recommended 12".
   d. 3" clear space below the tray.
2. Exception: other services may pass through the free clearance zone provided it is perpendicular to the tray direction and providing they do not exceed 6' in width or interfere with the access to pull wire in the tray.
3. When basket tray is installed in Hard Lid or decorative locations, access panel locations must be installed at corners or at T intersections. Consult DCO personnel on placement.
4. NOTHING shall be attached to the basket tray or basket tray supports without prior written approval from DCO.



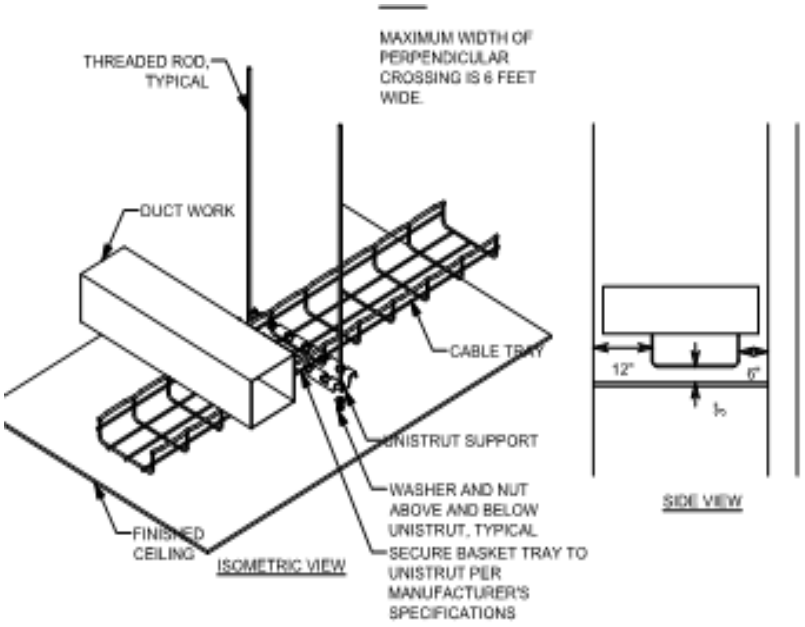
3.2 **ROUTING OF BASKET TRAY**

A. The exact basket tray location shall be coordinated with other trades to ensure proper clearances and access. Prior to installation, final cable tray routes must be approved by the Owner's DCO/Infrastructure cabling team.
B. Basket tray shall be installed in straight lines, either parallel or perpendicular to building lines
C. Wire basket trays are assumed to include joiner kits, stabilizer kits, rack mount kits, splices, clamps, hangers, supports, waterfalls, and thus no accessories are called out below except the tray divider.
D. Cut basket tray structural components/rods will not be left with any edges that can cause injury to the skin and eyes by a person who is in the ceiling working. Cut ends are to be covered with a coating or cap.
E. All changes in cable elevation(s) transitioning between basket tray, or cable rack will be protected using a waterfall device.
    1. This may also be mitigated by creating a rack 'ramp' which lowers the upper rack to the lower rack by cutting and bending the upper rack to slope downward to the lower rack.
    2. This method requires DCO pre-approval and proper ceiling support for the ramp.
F. Basket tray shall follow corridor paths
    1. Routing above rooms and other partitions shall be avoided
    2. The cable tray shall not block access to VAV's valves or other like equipment.
G. Basket tray and flush penetrations shall be utilized over hard-lid areas as specified.
H. Access panels shall be provided where needed to provide access to the basket tray on both sides of the wall in hard lid areas within 3' or less of the basket tray.

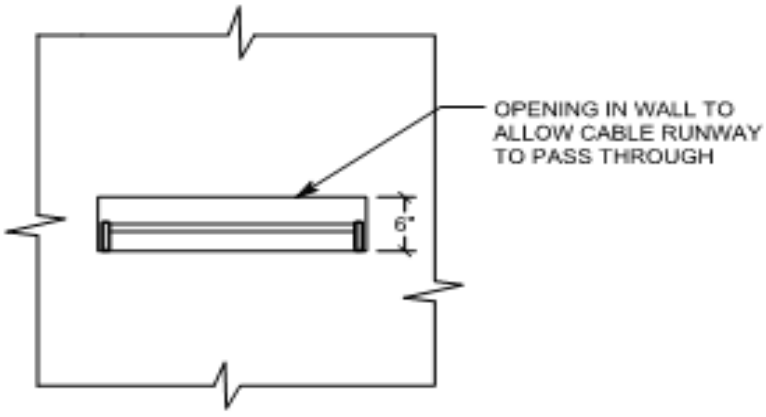
3.3 **TRAY INTEGRITY**

A. Tray shall be installed as a complete, continuous system with no open spaces, cut outs, or missing segments. Bonding between sections shall be accomplished by the manufacturer's approved clamp or designated method.
B. Trays shall be free from obstructions, other systems, trash or debris. Access to the tray shall be provided as outlined.
C. No other trades infrastructure or equipment may be connected to or rely on the basket tray or its support system.
D. Tray must not be notched or cut-out to accommodate other trades. Repairs will not be accepted. Section replacement will be required at no cost to the owner.

E. As much tray material as possible shall be left uncut at turns, junctions, elevation changes, width changes, etc. Overlap shall be clamped to maximize strength and prevent pinch points.



TYPICAL CABLE TRAY WITH PERPENDICULAR CROSSING



CABLE RUNWAY THROUGH WALL DETAIL

3.4 WALL OR OTHER PENETRATIONS (SUBMITTAL REQUIRED)

A. Fire and smoke rated assemblies
   1. Penetrations shall comply with all fire and smoke prevention methods per code and as outlined elsewhere in this document, including Section 270528 and Division 7 (Thermal and Moisture Protection).

B. Approved penetration methods
   1. The preferred barrier penetration method shall be to run the tray continuous through the barrier, with closure provided by Firestop pillows.
      a. Framing shall be boxed around openings to permit proper pillow insertion. Coordinate with framing contractor.
   2. Sleeves or conduits
      a. Fire assemblies or alternate penetrations must provide 150% of the designed cross-sectional area of the basket.
      b. Conduit permitted only with written pre-bid permission or engineering notation on the drawings.
      c. Each penetration sleeve or conduit shall be bonded on both sides of the penetrated barrier using UL and AHJ approved methods.
   3. All penetrations shall be positioned in-line with the basket tray to facilitate ease of pulling conductors and provide a straight-line path.
      a. The bottom of the penetration device shall be flush with the bottom of the basket tray
      b. Side-to-side penetrations must be completely within the cable tray space or directly above whenever possible.
   4. Approved penetration devices shall be a minimum size of 4”
      a. Total penetration space at each location shall be sized for 20% growth and be equal to or greater than the cross-sectional area of the basket tray.
      b. Approved devices where smaller penetrations are permitted shall be a minimum size of 1”.
   5. Approved devices shall be approved by the local facility manager:
      a. Fire rated assemblies
      b. Tray with enclosed walls, properly sized and installed pillows
      c. Conduit sleeves
         1) Conduit sleeves should only be used as a last resort upon approval from owner’s DCO representative.

3.5 UTILIZATION

A. Capacity
   1. Trays and penetration devices shall be properly sized
      a. Provide a maximum calculated fill ratio of 40% to an inside depth not to exceed 3 inches (75 mm)
      b. Provide capacity to allow for at least 20% future growth

B. Systems served
   1. Basket trays, J-hooks, and penetrations shall be dedicated to a single system. Mixing of other systems with voice and data shall not be permitted in tray or J-hook paths.

C. Restricted content in trays
   1. The wire basket tray shall only contain cables for the voice and data communications systems.
      a. If there is sufficient space in the tray, and with approval from both the data network sub-contractor and DCO, certain other IP services may share tray space. (i.e. camera, telemetry, similar).
      b. Service loops must not reduce tray capacity.
      c. Nurse call cabling shall be run in the J-Hook path. All nurse call installations must provide their own path or utilize the triple J-Hook system.

D. Triple J-Hook
   1. Triple Tree J-Hooks – Caddy CAT64HPS WM3
   2. Path Assignments
      a. The Lower tier of the triple J-Hook path is designated for Card Access and building automation and controls
      b. The Middle tier of the triple J-Hook path is designated for Nurse Call.
      c. The Top tier of the triple J-Hook path is designated for satellite, DAS, or similar systems.
   3. When a triple J-hook pathway is not installed or available each system provider shall install their own j-hook pathway and wall penetrations.
   4. Service loop and slack shall not interfere with other pathways.
   5. Triple J-Hooks must be a minimum of 4" hooks each.

END OF SECTION

SECTION 270543-46

UNDERGROUND DUCTS, UTILITY POLES, AND RACEWAYS FOR INTER-BUILDING/CAMPUS CABLE ROUTING

PART 1 - PRODUCTS

1.1 INTER-BUILDING/CAMPUS CABLE ROUTING

A. The backbone subsystem shall include cable installed between buildings via approved underground, tunnel, direct -buried, aerial or any combination of these from the Campus Distributor/Main Cross-connect (CD/MC/TEC) to Building Distributor/Intermediate Cross-connect (BD/IC/TDR) in a multi-building campus.
   1. 4" Conduit is required
   2. (3) 1 ¼" inner ducts shall be installed in (1 out of 2 or 2 out of 4) 4" conduits going building to building.
   3. (2) 12.7/10 microduct and (1) 1 1/4" inner ducts shall be installed in (1 out of 2 or 2 out of 4) 4" conduits going building to building.
   4. Armored Fiber is required.
   5. Microduct/microfiber is optional.
   6. All outdoor conduits must be capped.

B. Backbone pathways shall be installed or selected such that the minimum bend radius and pulling tension of backbone cables is kept within cable manufacturer specifications both during and after installation.

C. In an underground system, adequate underground conduit space shall be available and accessible at each building. The conduits shall not exceed a fill ratio of 40%.
   1. All underground systems shall be designed to prevent water runoff from entering the building. All underground systems must be cleared of moisture prior to installation of any cable type. These systems must be sealed at both ends when not in use and after cable installation to prevent moisture and rodent infiltration.

PART 2 - EXECUTION

2.1 INSTALLATION

A. The backbone cables shall be installed in a hierarchical star topology, emanating from the Campus Distributor/Main Cross-connect to each satellite building, Building Distributor/Intermediate Cross-connect or Floor Distributor/Horizontal Cross-connect located in a telecommunication room. All Inter-building/Campus cables shall be installed to the applicable codes and regulations.

B. Where redundant paths are required, they shall be separated by a minimum of 24".
   1. Separate innerducts are required for each leg of the redundant path.
   2. Separate physical routes for each path shall be utilized where possible.

C. Optical fiber shall be run for all Inter-building/Campus backbone segments, and as a recommendation, at least one balanced twisted-pair cable should be run for each Inter-building backbone segment.
   1. Fibers will be Fusion Spliced in the telecommunications rooms using LC Pigtails in wall mounted interconnect centers or rack mounted panels equipped with enough ports, slack storage space and splice trays if required to terminate and secure all fibers.

D. ST connectors are no longer recommended in the TIA 568-C.3 standard but may be used in legacy installations.

E. Over-voltage Circuit Protection shall be utilized for cabling which enters or exits a building shall comply with applicable codes and regulations.

F. OSP (outside plant) cables shall transition to an ISP (inside plant) within 50 feet of changing environment, per national and local codes and regulations.

END OF SECTION

SECTION 270553

IDENTIFICATION FOR LOW-VOLTAGE CABLES AND LABELING

PART 1 - GENERAL

1.1 **NOT USED**

PART 2 - PRODUCTS

2.1 **LABELING**

A. Structured cabling shall be labeled in accordance with ANSI/TIA 606-B standards.
B. A unique identifier shall be marked on each faceplate to identify it as connecting hardware.
C. Each port in the faceplate shall be labeled with its identifier.
D. A unique identifier shall be marked on each piece of connecting hardware to identify it as connecting hardware.
E. Each port on the connecting hardware shall be labeled with its identifier.
F. Cable Labeling
    1. Label System
        a. Labels Identification (Labeling) System:
            1) Brady
            2) Dymo
            3) Hellerman-Tyton
            4) Panduit
            5) Acceptable alternate
                a) Approval from Data Center Operations Infrastructure Cabling team member required prior to bid.
    2. Cable Labels
        a. Self-adhesive vinyl or vinyl-cloth wraparound tape markers, machine printed with alphanumeric cable designations. Plastic, self-adhesive labels are not acceptable.
        b. Each end of the Horizontal cables shall be labeled with a mechanically generated label within 300mm (12 in) of the end of the cable jacket with the link identifier which shall be a unique configuration determined by owner. This also applies to Backbone Cables.
    3. Flat-surface labels
        a. Self-adhesive vinyl or vinyl-cloth labels, machine printed with alphanumeric cable designations.
    4. Contractor shall:
        a. Provide transparent plastic label holders, and 4 pair marked colored labels.
        b. Install colored labels according to the type of field as per ANSI/TIA 606-B.1 color code designations.
G. Palette
    1. Use the owners color-code guidelines for voice, data, cross-connect, riser, and backbone fields. Otherwise, use the ANSI/TIA 606-B designation strip color-code guidelines for voice, data, cross-connect, riser, and backbone fields. Color designations for F/UTP cable:
        a. Intermountain Health Standard Wiring Palettes for Horizontal Cabling
        b.

Use		Color
1)	Data & IP Phones	Blue
2)	Analog Phone	Blue
3)	Security Card Readers	Grey/Yellow
4)	IP Security Cameras	Blue
5)	Fire Systems	Red
6)	TV Coax	Black

7)	Public Address/Telecom Patching in TEC only	White
8)	Clinical Engineering –	Orange
	a) Monitoring, Bed Systems	Orange
	b) Nurse Call (5e)	Orange
	c) Real time patient data	Orange
9)	Wireless	Yellow
10)	Foreseer (Belden 1422)	Red

H. Outlet/Jack/Faceplate Icons/labeling will match the color of the cable attached to the back side of the outlet/jack.

PART 3 - EXECUTION

3.1 **GENERAL IDENTIFICATION**

A. The installer shall label all cables, regardless of length.

B. Identify system components, wiring, and cabling complying with TIA/EIA-606-B.1. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

C. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.

D. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.

E. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of comprehensive final schedules for Project.

F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications rooms, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-B.1. Furnish electronic record of all drawings, in software and format selected by Owner.

3.2 **CONCEALED ENDS**

A. Jacks, connectors, terminations, and similar that are in concealed locations such as above grid ceilings, shall have additional labeling. The additional label shall be on the face of the grid in a visible location, immediately adjacent to the termination location.

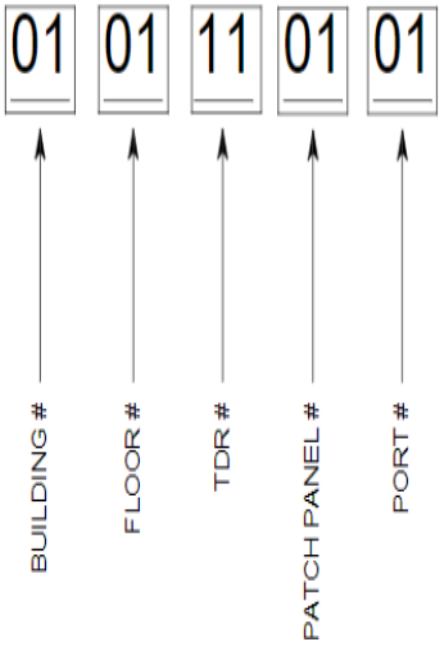
3.3 **CABLE AND WIRE IDENTIFICATION**

A. Label each cable visibly within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

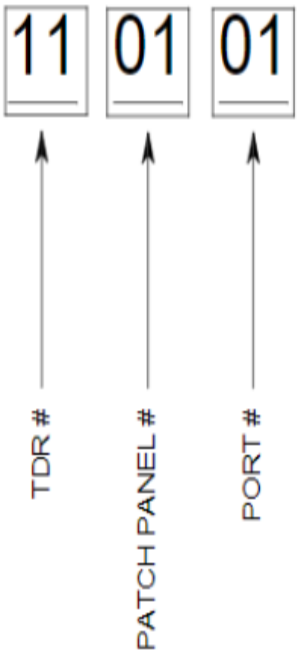
B. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.

C. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

1. Individual number wiring conductors connected to terminal strips and identified each cable or wiring group being extended from a panel or cabinet to a building.
   The mounted device shall be identified with the name and number of devices as shown.
2. Label each unit and field within distribution racks and frames.
3. Cable ID Example



4. Building # - The building number is assigned to the building if there are multiple buildings.
   Floor # - Will be incorporated into the TDR #
   TDR # - Begin with 1A through 1Z for 1st Floor – 2A and so on per the floor the cabling in on.
   Patch Panel # - 1 through however many patch panels there are.
   Port # - 1 -48 for each patch panel.
5. Cable ID Example for Small Clinics.



D. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-B.1.

END OF SECTION

SECTION 271100

EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Requirements of the following Division 26 sections apply to this section.
   1. Basic electrical requirements
   2. Basic electrical materials and methods
   3. Grounding, earthing, and bonding.

B. Standards
   1. Minimum equipment room specifications shall comply with the 2010 AIA Guidelines for Design and Construction of Health Facilities.
   2. Minimum recommended room sizes are requirements, not suggestions.
   3. Enterprise IS Architecture (EISA) maintains several documents around standards. The primary standards list is the EISA Standards 2010 – Master List. Occasionally, there is a need to break-out specific standards for an area.

1.2 SUMMARY

A. This Section specifically details the facilities design and operations standards to be utilized for Intermountain Health Care's Data Rooms (TEC) and data closets (TDR).

1.3 COMMON REQUIREMENTS

A. Rack layout and mounting
   1. Standard room layouts are located on the plans.

B. Rack and wall mounting locations.
   1. Rack and wall space use is pre-designated at the design stage. Before mounting any equipment on a wall or in a rack, the location must be verified by the Div 27 sub-contractor and Data Center Operations.

C. All Data Centers, TEC's, TSER's, TDR's, Cabinets and Clam Shells must be secured with either a Card Reader, Electronic Key or a secure device that is recordable and auditable.

1.4 DEFINITIONS

A. **Data Center** – Major computer/technology/network facilities providing a significant percentage of the data and application services for the enterprise.

B. **Data Rooms – ((TEC) Technology Equipment Center)** – Purpose built buildings or rooms that provide communications point-of-presence along with some data and applications services for a local facility or region.

C. **TSER (Telecommunications Service Entrance Room)** – Houses the point at which data and voice circuits and services enter the facility and outdoor cabling interfaces with the building infrastructure. Typically, the TSER will be in the TEC.

D. **Data Closets – (TDR) Technology Distribution Room)** – Specific location within a facility that provides communication services for a specific area (floor, wing, office area) of that facility only. A secure, flexible, and easily managed location for structured cabling systems, network electronics, clinical systems, nurse call systems, and other technology and communications equipment.

E. **Wall Mountable Cabinets –** Specific location within a facility that provides communication services for a specific area when there is not available space for a

   TDR within that space only. A secure, flexible, and easily managed location for structured cabling systems, network electronics, clinical systems, nurse call systems, and other technology and communications equipment.

PART 2 - TECHNOLOGY ROOM SPECIFIC REQUIREMENTS

2.1 **TECHNOLOGY EQUIPMENT CENTER (TEC)**

A. Each Hospital will have a dedicated TEC which will serve as the main communications point-of- presence along with data and application services for the local facility or region. Houses the core networking equipment, application servers and data storage devices
that serve the buildings on the campus. The Telecommunications Service Entrance Room (TSER) will be in the same room.

2.2 **TEC IN HOSPITALS**

A. Physical Construction
1. The TEC should be in an area easily accessed for delivery of equipment and high traffic without disturbing patient care.
2. The size of the TEC will be based on the number of cabinets required to support the campus, plus 30% growth.
3. TEC should at a minimum be sized to house the following:
   a. 13 – Data Cabinets
   b. 3 – in-row colling units ex. Liebert CRV
   c. 2 – in-row UPS units
   d. 2 post patching field for inter TEC cabinets connections for both copper and fiber.
   e. Wall space for inter TEC electrical distribution panels, transformers and MBP's.
4. Walls will be constructed from the floor to the deck and be completely sealed from surrounding spaces.
   a. All usable wall space will be covered by ¾"x4'x8' Grade AC fire rated plywood with a minimum of 50% of wall space covered in ¾" fire rated plywood.
   b. Fire rated plywood shall be painted with bright white fire-resistant paint.
   c. Paint must not cover the fire rating stamp on the plywood. 1 stamp per piece of plywood must be taped off to not be painted.
   d. Mount 6" AFF
5. The TEC should not have a ceiling other than exposed structure.
6. Static Dissipative Tile is required in the TEC.
7. The door to the TEC shall be 8'-0" x 4'-0" to accommodate the cabinet height.
8. The walls of the TEC should not have any windows installed.
9. The TEC will not have infrastructure that serves other trades pass through the TEC other than that infrastructure that serves the TEC
10. All pressurized supply piping and drain piping will have drip pans or other means installed to contain any failure of these systems.

B. Layout
1. Cabinets will be laid out in a cold isle configuration.
2. All isles, inside and outside will be a minimum of 4' wide
3. Containment will be installed, including removable ceiling panels and isle doors.

C. Electrical
1. The electrical distribution system will follow an A (BLUE) – B (RED) design.
2. Each system A (BLUE) and B (RED) will be backed up by a dedicated UPS.
3. Source A shall be supplied by a dedicated emergency circuit backed up by a dedicated UPS.
   a. Maintenance Bypass Wraparound or equivalent shall be installed.
4. Source B shall be supplied by a dedicated emergency circuit from a different ATS system from Source A and backed by a dedicated UPS.
   a. Maintenance Bypass Wraparound or equivalent shall be installed.
5. Cabinet 0utlet type is L21-30

6. Provide convenience outlets around the room.
7. All power is to be run in conduit.
8. Lighting will be installed above each isle and be supplied by an emergency circuit.

D. Mechanical
1. The mechanical system will be a precision cooling solution installed in an in row, N+1 configuration designed to maintain 72 degrees F at mid cabinet.
2. The mechanical system will be redundant and concurrently maintainable, including on the electrical supply.
3. The system shall meet engineering specifications for the room at 110 degrees outside air at 4500 feet above sea level.
4. Chilled water, DX (Air Cooled) and Glycol (30% polyethylene glycol to water) are all acceptable cooling strategies.
5. The GC, Mechanical Engineer and Mechanical Contractor are responsible for the complete installation of the cooling equipment and auxiliary devices included with the equipment. Auxiliary equipment includes but not limited to in-row temperature sensors, leak detection and local or remote monitoring hardware.

E. Security
1. Doors will be fitted with an auditable card reader.
2. Doors will have an electronic key cylinder installed.

F. Fire System
1. A pre-action dry pipe fire system will be installed.
2. Sprinkler fuses will be rated at 200 degrees F or higher, whatever is allowed.
3. Sprinklers should be protected from accidental activation.
4. The primary fire detection system will be provided by the facility system.
5. The secondary detection system is a VESDA system monitored by the Lake Park Data Center.

G. Monitoring
1. The Eaton Foreseer system will be used to monitor all critical systems.
2. Foreseer cables will be run to all UPSs, cooling units and TDRs.
3. One Cat 6a F/UTP cable to each UPS.

2.3 TEC in Clinics and Office Buildings

A. Clinics and Offices will have a room which will serve as a TEC and TDR. This room will be sized to accommodate the multifunction of the space.

B. TEC size will be 12’ x 16’

2.4 TEC/TDR in Clinics

A. Physical Construction
1. TDRs should be in a central location off the main corridor away from patient areas.
2. TDRs should be stacked from floor to floor.
3. TDR size will be at least 12’ x 16’.
4. Walls will be constructed from the floor to the deck and be completely sealed from surrounding spaces.
   a. All usable wall space will be covered by ¾”x4’x8’ Grade AC fire rated plywood with a minimum of 50% of wall space covered in ¾” fire rated plywood.
   b. Fire rated plywood shall be painted with bright white fire-resistant paint.
   c. Paint must not cover the fire rating stamp on the plywood. 1 stamp per piece of plywood must be taped off to not be painted.
   d. Mount 6” AFF
5. The TDR should not have a ceiling other than an exposed structure.
6. Flooring can be Static Dissipative Tile or Epoxy Paint.
7. A 3’-0” x 7’0” door is required.
8. When permissible, doors shall swing out of the room to provide maximum available space and rapid egress.

B. Layout
1. Racks in a single row with the front being the cold isle.

2. The front of the racks should face the door.

C. Electrical
1. The electrical distribution system will follow an A (BLUE)-B (RED) design.
2. System A(BLUE) will be backed up by a dedicated UPS.
3. System B(RED) will be from a dedicated Emergency or Utility circuit.
4. The outlet type is L6-30 and L5-20.
5. Provide convenience outlets around the room.
6. All power is to be run in conduit.
7. Lighting will be installed above each isle.

D. Mechanical
1. TDRs will have redundant cooling.
   a. Primary cooling is from the facility cooling system via a dedicated source.
   b. Secondary cooling is from a standalone split or ceiling mount source.
   c. The secondary system will be fed from the facility generator equipment electrical source if available.
   d. The Mechanical system will be designed to maintain 72 degrees F at mid rack.
   e. The coordination scheme between primary and secondary cooling systems can be accomplished by setting the primary system to 72 degrees F and the secondary system to 75 degrees F.

E. Security
1. Doors will be fitted with an auditable card reader.
2. Doors will have an electronic key cylinder installed.

F. Fire System
1. TDRs will utilize the facility fire detection and suppression systems.
2. Sprinkler heads should have a 200-degree fuse.
3. Sprinklers should be protected from accidental activation.

G. Monitoring
1. TDRs will be monitored using Eaton/Foreseer.
2. Run 3 foreseer cables to each TDR.
3. One Cat6a F/UTP cable to each UPS.

2.5 **TEC/TDR in Offices**

A. Physical Construction
1. TDRs should be in a central location off the main corridor.
2. TDRs should be stacked from floor to floor.
3. TDR size will be at least 12’ x 16’.
4. Walls will be constructed from the floor to the deck and be completely sealed from surrounding spaces.
   a. All usable wall space will be covered by ¾”x4’x8’ Grade AC fire rated plywood with a minimum of 50% of wall space covered in ¾” fire rated plywood.
   b. Fire rated plywood shall be painted with bright white fire-resistant paint.
   c. Paint must not cover the fire rating stamp on the plywood. 1 stamp per piece of plywood must be taped off to not be painted.
   d. Mount 6” AFF
5. The TDR should not have a ceiling other than an exposed structure.
6. Flooring can be Static Dissipative Tile or Epoxy Paint.
7. A 3’0” x 7’0” door is required.
8. When permissible, doors shall swing out of the room to provide maximum available space and rapid egress.

B. Layout
1. Racks in a single row with the front being the cold isle.
2. The front of the racks should face the door.

C. Electrical
1. The electrical distribution system will follow an A (BLUE)-B (RED) design.
2. System A(BLUE) will be backed up by a dedicated UPS.
3. System B(RED) will be from a dedicated utility circuit.
4. The outlet type is L6-30 and L5-20.

5. Provide convenience outlets around the room.
6. All power is to be run in conduit.
7. Lighting will be installed above each row.

D. Mechanical
1. TDRs will have a redundant cooling system designed to maintain 72 degrees F at mid rack.
   a. Primary cooling is from the facility cooling system via a dedicated source.
   b. Secondary cooling is from a standalone split or ceiling mount source.
      1) The secondary system will be fed from the facility generator equipment electrical source if available.
   c. The coordination scheme between primary and secondary cooling systems can be accomplished by setting the primary system to 72 degrees F and the secondary system to 75 degrees F.

E. Security
1. Doors will be fitted with an auditable card reader.
2. Doors will have an electronic key cylinder installed.

F. Fire System
1. TDRs will utilize the facility fire detection and suppression systems.
2. Sprinkler heads should have a 200-degree fuse.
3. Sprinklers should be protected from accidental activation.

G. Monitoring
1. TDRs will be monitored using Eaton/Foreseer.
2. Run 3 foreseer cables to each TDR.
3. One Cat 6a F/UTP cable to each UPS.

2.6 TECHNOLOGY DISTRIBUTION ROOM (TDR)

A. There shall be a minimum of one TDR on each floor of the facility. TDRs shall be provided throughout the facility as necessary to meet the 292' (90-meter) maximum cables distance. The TDR is located on each floor within a facility to house equipment and cabling, providing communication and technology services for a specific area of that facility. Based on the different needs of different facilities, the TDR's will be broken down into three categories. Hospital, Clinic and Office spaces.

2.7 TDR IN HOSPITALS

A. Physical Construction
1. TDRs should be in a central location off a main corridor and away from patient areas.
2. TDRs should be stacked from floor to floor.
3. TDR size will be at least 14' x 16'.
4. Walls will be constructed from the floor to the deck and be completely sealed from surrounding spaces.
   a. All usable wall space will be covered by ¾"x4'x8' Grade AC fire rated plywood with a minimum of 50% of wall space covered in ¾" fire rated plywood.
   b. Fire rated plywood shall be painted with bright white fire-resistant paint.
   c. Paint must not cover the fire rating stamp on the plywood. 1 stamp per piece of plywood must be taped off to not be painted.
   d. Mount 6" AFF
5. The TDR should not have a ceiling other than an exposed structure.
6. Flooring can be Static Dissipative Tile or Epoxy Paint.
7. A 3'0" x 7'0" door is required.
8. When permissible, doors shall swing out of the room to provide maximum available space and rapid egress.

B. Layout
1. Racks will be in a cold isle configuration.
2. Two rows with the cold aisle in the middle.

C. Electrical
1. The electrical distribution system will follow an A (BLUE)-B (RED) design.

2. Each system A(BLUE) and B(RED) will be backed up by a dedicated UPS.
3. The outlet type is L6-30 and L5-20.
4. Provide convenience outlets around the room.
5. All power is to be run in conduit.
6. Lighting will be installed above each isle.

D. Mechanical
1. TDRs will have redundant cooling designed to maintain 72 degrees F at mid rack.
   a. Primary cooling is from the facility cooling system via a dedicated source.
   b. Secondary cooling is from a standalone split or ceiling mount source.
   c. The secondary system will be fed from the facility generator equipment electrical source if available.
   d. The coordination scheme between primary and secondary cooling systems can be accomplished by setting the primary system to 72 degrees F and the secondary system to 75 degrees F.

E. Security
1. Doors will be fitted with an auditable card reader.
2. Doors will have an electronic key cylinder installed.

F. Fire System
1. TDRs will utilize the facility fire detection and suppression systems.
2. Sprinkler heads should have a 200-degree fuse.
3. Sprinklers should be protected from accidental activation.

G. Monitoring
1. TDRs will be monitored using Eaton/Foreseer.
2. Run 3 foreseer cables to each TDR.
3. One Cat 6a F/UTP cable to each UPS.

2.8 **TDR in Clinics**

A. Physical Construction

1. TDRs should be in a central location off a main corridor and away from patient areas.
2. TDRs should be stacked from floor to floor.
3. TDR size will be at least 10’ x 12’.
4. The TDR size in Clinics is 6000 sq. ft. or less will be at least 8’ x 8’ or as approved by Intermountain IS/IT team based on functional layout of TDR equipment.
5. TDR size in Clinics for Tenants Demarc will be at least 5’ x 5’.
6. Walls will be constructed from the floor to the deck and be completely sealed from surrounding spaces.
   a. All usable wall space will be covered by ¾”x4’x8’ Grade AC fire rated plywood with a minimum of 50% of wall space covered in ¾” fire rated plywood.
   b. Fire rated plywood shall be painted with bright white fire-resistant paint.
   c. Paint must not cover the fire rating stamp on the plywood. 1 stamp per piece of plywood must be taped off to not be painted.
   d. Mount 6” AFF
7. The TDR should not have a ceiling other than an exposed structure.
8. Flooring can be Static Dissipative Tile or Epoxy Paint.
9. A 3’-0” x 7’-0” wide door is required.
10. When permissible, doors shall swing out of the room to provide maximum available space and rapid egress.

B. Layout
1. Racks in a single row with the front being the cold isle.
2. The front of the racks should face the door.

C. Electrical
1. The electrical distribution system will follow an A (BLUE)-B (RED) design.
2. System A(BLUE) will be backed up by a dedicated UPS.
3. System B(RED) will be from a dedicated utility circuit.
4. The outlet type is L6-30 and L5-20.
5. Provide convenience outlets around the room.

6. All power is to be run in conduit.
7. Lighting will be installed above each isle.

D. Mechanical
1. TDRs will have redundant cooling designed to maintain 72 degrees F at mid rack.
   a. Primary cooling is from the facility cooling system via a dedicated source.
   b. Secondary cooling is from a standalone split or ceiling mount source.
   c. The secondary system will be fed from the facility generator equipment electrical source if available.
   d. The coordination scheme between primary and secondary cooling systems can be accomplished by setting the primary system to 72 degrees F and the secondary system to 75 degrees F.

E. Security
1. Doors will be fitted with an auditable card reader.
2. Doors will have an electronic key cylinder installed.

F. Fire System
1. TDRs will utilize the facility fire detection and suppression systems.
2. Sprinkler heads should have a 200-degree fuse.
3. Sprinklers should be protected from accidental activation.

G. Monitoring
1. TDRs will be monitored using Eaton/Foreseer.
2. Run 3 foreseer cables to each TDR.
3. One Cat 6a F/UTP cable to each UPS.

2.9 **TDR in Offices**

A. Physical Construction
1. TDRs should be in a central location off the main corridor.
2. TDRs should be stacked from floor to floor.
3. TDR size will be at least 10' x 12'.
4. Walls will be constructed from the floor to the deck and be completely sealed from surrounding spaces.
   a. All usable wall space will be covered by ¾"x4'x8' Grade AC fire rated plywood with a minimum of 50% of wall space covered in ¾" fire rated plywood.
   b. Fire rated plywood shall be painted with bright white fire-resistant paint.
   c. Paint must not cover the fire rating stamp on the plywood. 1 stamp per piece of plywood must be taped off to not be painted.
   d. Mount 6" AFF
5. The TDR should not have a ceiling other than an exposed structure.
6. Flooring can be Static Dissipative Tile or Epoxy Paint.
7. A 3'0" x 7'0" door is required.
8. When permissible, doors shall swing out of the room to provide maximum available space and rapid egress.

B. Layout
1. Racks in a single row with the front being the cold isle.
2. The front of the racks should face the door.

C. Electrical
1. The electrical distribution system will follow an A (BLUE)-B (RED) design.
2. System A(BLUE) will be backed up by a dedicated UPS.
3. System B(RED) will be from a dedicated utility circuit.
4. The outlet type is L6-30 and L5-20.
5. Provide convenience outlets around the room.
6. All power is to be run in conduit.
7. Lighting will be installed above each isle.

D. Mechanical
1. TDRs will have redundant cooling designed to maintain 72 degrees F at mid rack.
   a. Primary cooling is from the facility cooling system via a dedicated source.
   b. Secondary cooling is from a standalone split or ceiling mount source.

c. The secondary system will be fed from the facility generator equipment electrical source if available.
d. The coordination scheme between primary and secondary cooling systems can be accomplished by setting the primary system to 72 degrees F and the secondary system to 75 degrees F.

E. Security
1. Doors will be fitted with an auditable card reader.
2. Doors will have an electronic key cylinder installed.

F. Fire System
1. TDRs will utilize the facility fire detection and suppression systems.
2. Sprinkler heads should have a 200-degree fuse.
3. Sprinklers should be protected from accidental activation.

G. Monitoring
1. TDRs will be monitored using Eaton/Foreseer.
2. Run 3 foreseer cables to each TDR.
3. One Cat 6a F/UTP cable to each UPS.

2.10 WALL MOUNT CABINET

A. Physical Condition
1. Wall mount cabinet should only be used when there is not space for a TDR.

B. Electrical
1. Power should be run into the back of the cabinet.

C. Mechanical
1. The cabinet should have a factory fan installed.

D. Security
1. The door will have an electronic key cylinder installed.

PART 3 - EXECUTION

3.1 COMMON REQUIRED CHARACTERISTICS FOR TDR, TEC, & TSER

A. SECURITY - COMMON
1. Any visitor, vendor, or contractor requiring access to a Technology Room, who does not have appropriate approvals or clearances, must be escorted by a properly credentialed tech from the appropriate system.
2. The main technology equipment shall be secured in a dedicated, locked Technology Room.
3. Unused access jacks should be disconnected from the patch panels, and unused switch ports disabled.
4. Technology Rooms shall be dedicated to the data and telecommunications functions.
5. Access to the Technology Room shall be restricted to authorized service personnel and shall not be shared with building services that may interfere with the main networking interfaces, the networking equipment, the application servers, data storage devices, and telecommunications equipment systems.
6. Technology Rooms shall not be used for building maintenance services, custodial services, or be used for general storage.
7. Security cameras may be installed in each Technology Room upon the owner's preference.
a. At the back wall facing the door but directed to not see the equipment in the racks, end of each row of equipment racks.
b. In electrical and mechanical rooms serving the Technology Room
c. Approved camera manufacturers: Axis and Bosch
8. Access to a Technology Room shall be restricted and controlled by an auditable access control system. The access control system shall comply with the requirements of this document.
9. All secure data areas must be secured by an auditable badge reader system.

a. Refer to plans or quotes for detailed information.
b. Approved supplier: Intermountain Lock and Security Supply / 3106 S Main St / Salt Lake City, UT 84115 / 801-486-0079
c. Owner of security locks and badge readers: Intermountain Healthcare Data Center
d. For programing on the Medeco XT Electronic Keys contact: Intermountain Healthcare Data Center

B. PHYSICAL ENVIRONMENT
1. The Technology Room shall be in a dry area not subject to flooding and should be as close as possible to the electrical service room to reduce the length of the bonding conductor to an electrical grounding system.
2. The Technology Room shall be in an accessible, non-sterile area.
3. Access to the Technology Room shall be directly off a corridor and not through another space.
4. The Technology Room shall be located to avoid large ducts, beams, and other building elements that may interfere with proper cable routing and may limit future access.
5. Mechanical and electrical equipment or fixtures not directly and exclusively related to the support of the Technology Room shall not be installed in, pass through, or enter the Technology Room.
6. Technology rooms shall not be located on exterior walls.
7. Technology rooms shall not have windows or other exterior openings.

3.2 TECHNOLOGY DISTRIBUTION ROOM (TDR) / DATA CLOSET

A. ELECTRICAL ENVIRONMENT
1. Separation from sources of EMI shall be in accordance with ANSI/TIA/EIA-569-C and local codes.
2. Communication grounding/earthing and bonding shall be in accordance with applicable codes and regulations. It is recommended that the requirements of IEC/TR3 61000-5-2 - Ed. 1.0, ANSI-J-STD-607-C, or both, be observed throughout the entire cabling system.
   a. All racks, equipment frames, furniture, flooring, and ductwork within the IT space shall be bonded to the Central Ground bar provided and installed by Division 26.
      1) No AC electrical equipment bonding will be done at the Central Ground Bar. AC electrical grounding and bonding will be done according to the NEC.
3. Some TDRs will require redundant power and data feeds. See plans and drawings.
4. Lighting in the TDRs should be a minimum of 500 lx (50-foot candles) at the lowest point of termination.
   a. Light switch should be easily accessible when entering the room.
   b. Lighting will be fed from the generator system or have fixtures with battery backup.
5. A minimum of two dedicated duplex or two dedicated simplex electrical outlets, each on a separate 120V 20A circuit, should be provided for equipment power.
   Additional convenience duplex outlets should be placed at 1.8 m (6 ft) intervals around the perimeter walls.
   a. Only twist lock receptacles will be used for rack power points. Type L-6-30R for 208 volts and type Nema L-5-20R for 120 volts.
6. All power originates from the facilities generator backup system with one system (A-B) originating from the critical system.
7. All circuits serving the TDR and the equipment within it shall be dedicated to serving the TDR.
8. TDRs shall be connected by a backbone of insulated, 6 (minimum) to 3/0 AWG stranded copper cable between all technology rooms. This cable shall be provided and installed by Division 26.

B. MECHANICAL ENVIRONMENT
1. Reliable cooling shall be provided.

a. Based on criticality tiering structure individual rooms may require redundant, concurrently maintainable cooling systems.
b. Tier structure level shall be determined from the design guide.

2. Heat load shall be calculated at 4KW per equipment rack
3. Temperature and humidity in the TDR shall be controlled to an operating range of 64 to 75 degrees F (18 to 24 degrees C) with 30 to 55 percent relative humidity.

C. EQUIPMENT
1. Each TDR shall be connected to the TEC (Technology Equipment Center) to provide a building-wide network and communications system.
2. All racks, cabinets, sections of cable tray, and metal components of the technology system that do not carry electrical current shall be grounded to a Telecommunication Grounding Bus Bar

3.3 TECHNOLOGY EQUIPMENT CENTER (TEC) / DATA ROOM

A. ELECTRICAL ENVIRONMENT
1. The TDR and TEC electrical environments shall match the following exceptions:
2. All circuits serving the TEC and the equipment within it shall be dedicated to serving the TEC.

B. MECHANICAL ENVIRONMENT
1. TEC and TSER have the same mechanical environment.
2. Reliable cooling shall be provided.
3. Heat load shall be calculated at 4KW per equipment rack.
4. Temperature and humidity in the TEC shall be controlled to an operating range of 64 to 75 degrees F (18 to 24 degrees C) with 30 to 55 percent relative humidity.

C. EQUIPMENT
1. Each TEC shall be connected to the TSER (Telecommunications Service Entrance Room) to provide an enterprise-wide network and communications system.
2. All racks, cabinets, sections of cable tray, and metal components of the technology system that do not carry electrical current shall be grounded to a Telecommunications Main Grounding Bus Bar.

3.4 TELECOMMUNICATION SERVICE ENTRANCE ROOM (TSER) / D-MARC

A. PURPOSE
1. The TSER (Telecommunications Service Entrance Room) equipment subsystem shall consist of shared (common) electronic communications equipment in the

2. TEC or the TSER required to interface this equipment and distribution hardware to the transmission media of enterprise-Wide Area Network (WAN) infrastructure.
3. The TSER shall be equipped to contain telecommunications equipment, cable terminations, and associated cross-connects.
   a. Note that the AIA/State guidelines specify that the minimum size for a TSER is 12’ by 14’.
   b. Doors shall swing out of the room to provide maximum available space and rapid egress.
      1) Exception: where prohibited by fire or safety code.
4. The TSER shall be dedicated to the telecommunications function.

B. MECHANICAL ENVIRONMENT
1. Reliable cooling and heating shall be provided.
2. Temperature and humidity in the TSER shall be controlled to an operating range of 64 to 75 degrees F (18 to 24 degrees C) with 30 to 55 percent relative humidity.

C. EQUIPMENT
1. The TSER (Telecommunications Service Entrance Room) shall be connected to the specified WAN equipment to provide connectivity to the enterprise-wide network and communications system.

2. All racks, cabinets, sections of cable tray, and metal components of the technology system that do not carry electrical current shall be grounded to a Telecommunications Main Grounding Bus Bar.

END OF SECTION

SECTION 271116

**CABINETS, RACKS, FRAMES,
AND ENCLOSURES**

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS**

A. Cabinets and racks specifications are in TIA569-C and in the ET pages of the plans.

PART 2 - PRODUCTS

2.1 **APPROVED PRODUCT**

A. OPEN RACKS
   1. For rack-mounted installations in a telecommunications room the installer shall use a 19-inch by 3-inch-deep equipment rack.
   a. Equipment Rack 19" X 8', 52 RU, Black – Chatsworth 55053-715
   b. Equipment Rack 19" X 7', 45 RU, Black – Chatsworth 55053-703
   c. Exception: Where other size cabinets are specified by design team at owner's direction
   d. All equipment racks must be bolted to the floor for seismic support.

B. WALL MOUNTED RACK
   1. Wall Mounted Rack 53.6" H x 17" D, 26RU, Black – Chatsworth 11807-718
   2. Heavy Duty Swing Gate – Chatsworth 12795-701

C. WIRE MANAGERS
   1. Part Numbers
      a. Vertical Wire Manager, Double Sided, Black 10" wide x 8' tall – Chatsworth 40096-715
      b. Vertical Wire Manager, Double Sided, Black 10" wide x 7' tall – Chatsworth 40096-703
      c. Horizontal Wire Manager, 4U – Panduit PR2HF4
   2. Typical Standard Layout
      a. The layout is 10" vertical manager, then 19" rack, then 10" vertical manager, then 19" rack, then 10" vertical manager.
      b. Where more than 2 racks are called for, maintain the pattern of 10" vertical wire management on the ends, and 10" vertical management between racks.

D. CABINETS
   1. Standard Cabinet
      a. DCE 1-Sided Cabinet – 600mm x 1200mm - Vertiv E4562121120001S
      b. DCE 2-Sided Cabinet – 600mm x 1200mm - Vertiv E4562122120001S
      c. DCE 1-Sided Cabinet – 700mm x 1200mm – Vertiv E4572112120001S
      d. DCE 2-Sided Cabinet – 700mm x 1200mm – Vertiv E4572122120001S
      e. Baying Gasket – Baying Gasket Kit – Vertiv E4013
      f. Baying Kit – Baying Hardware Kit – Vertiv E9013
      g. Blanking Panel – Upsite Hotlok 10031 1U
      h. Blanking Panel – Upsite Hotlok – 10033 2U
      i. All cabinets must be bolted to the floor for seismic support.
   2. Wall Mount Cabinet
      a. **Cube-It** – CPI 11996-736 (36" H x 30" D). Or specified size.
      b. Stand Fan and Filter Kit for Cube-It – CPI 40972-001
      c. Power strip for Cube-It – CPI 12820-705 (20 Amp – NEMA 5-20P)

d. Vertical Wall Mount Cabinet – Legrand VWMSD-4RU-42-B
e. Vertical Wall Mount Cabinet – Legrand VWMSD-8RU-42-B
f. Fixed Mounting Rail Kit – Legrand VWM-RR-4RU
g. Fixed Mounting Rail Kit – Legrand VWM-RR-8RU
h. Pivoting Mounting Rail Kit – Legrand VWM-PIV-4RU
i. Fan Kits with 115 VAC fans – Legrand VWMFK-115
j. Top Brush Grommet Kit – Legrand VWMBGK
k. Circular Knockout Grommet Kit – Legrand VWMGR-30
l. Vertical Wall-Mount Cabinets - Refrigerated Cabinet 24" – Hubbell IR221APG.
m. Vertical Wall-Mount Cabinets - Refrigerated Cabinet 36" – Hubbell IR321APG.
n. Vertical Wall-Mount Cabinets - Refrigerated Cabinet 48" – Hubbell IR421APG.
o. Air Conditioners – Aire conditioner for Hubbell refrigerated cabinets - Hubbell IRAC1

END OF SECTION

SECTION 271119

TERMINATION BLOCKS AND PATCH PANELS

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS**

A. Requirements of the following Division 26 sections apply to this section.
1. Basic electrical requirements
2. Basic electrical materials and methods
3. Grounding, Earthing, and Bonding

PART 2 - PRODUCTS

2.1 **APPROVED PRODUCT**

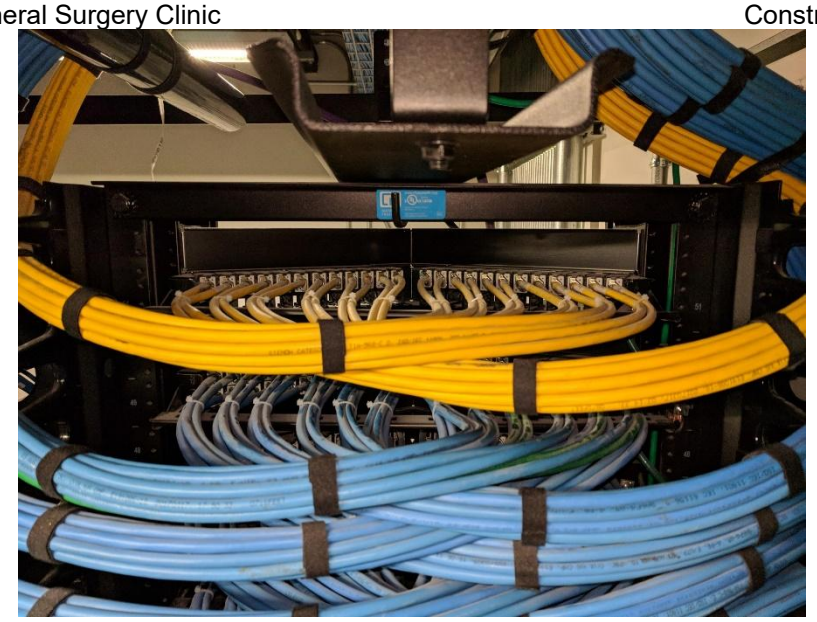
A. PATCH PANELS – COPPER
1. 48 Port CAT 6A Shielded, 1RU Angled Patch Panel with Outlets – Siemon Z6AS-PA-48A
2. 48 Port CAT 6A Shielded, 1RU Flat Patch Panel with Outlets – Siemon Z6AS-PNL-U48K
3. 24 Port CAT 6A Shielded, 1RU Plat Patch Panel with Outlets – Siemon Z6AS-PNL-U24K
4. 48 Port CAT 6, 2RU Angled Patch Panel, 110 Style – Siemon UP6-A2-48L-RS
5. 48 Port CAT 6, 2RU Flat Patch Panel, 110 Style – Siemon UP6-F2-48L-RS
6. 24 Port CAT 6, 1RU Angled Patch Panel, 110 Style – Siemon UP6-A1-24L-RS
7. 24 Port CAT 6, 1RU Flat Patch Panel, 110 Style – Siemon UP6-F1-24L-RS
8. 19” Angled Blank Filler Panel, 1U, Black – Siemon PNL-BLNKA-1
   a. Provide blank fillers where appropriate.
9. 19” Flat Blank Filler Panel, 1U, Black – Siemon PNL-BLNK-1
   a. Provide blank fillers where appropriate.

B. PATCH PANELS – FIBER
1. LightVerse Rack Mount Fiber Enclosure – Siemon LVE-4U-MD-P01A
2. Lightverse Blank Adapter Plate, Black – Siemon LVA-BLANK-01A
3. LightVerse LC Splice Cassette - Siemon LVS12-LSUARAB1A
4. LightVerse Splice Tray – Siemon TRAYHD—1-A
5. OM4 Splice Cassette – Siemon LVS12-LS-PVRAB1A
6. Wall Mount Fiber Enclosure – Siemon LVW-M1-01
7. Lightstack Surface Mount Module Enclosure – Siemon – LSE-01
8. Lightstack Surface Mount Splice Enclosure – Siemon – LSS-01
9. Lightstack LC Adapter Plate – Siemon LS-LS12-01C-AQ

PART 3 - EXECUTION

3.1 **INSTALLATION**

A. For angled patch panels, the terminations shall cross in the back to the opposite path of the patch panel to maximize available cable bend radius.
B. See illustration below in this section:



END OF SECTION

SECTION 271300

BACKBONE CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawing and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
B. Section 27 05 28 – Pathways for Communications Systems.

1.2 DEFINITIONS

A. INTRA-BUILDING CABLING
   1. Cable that runs between telecommunications rooms (TRs) inside a building. Can be vertical or horizontal in physical orientation. It consists of the backbone transmission media between these locations and the associated connecting hardware terminating this media.
B. INTER-BUILDING / CAMPUS CABLING
   1. Cable that runs between buildings in a campus environment. It is normally a first-level backbone cable beginning at the main cross-connect in the equipment room of the hub building and extending to the intermediate cross-connect in the equipment room of a satellite building. Campus Backbones require an optical fiber cable to be installed to support high speed data applications.
   2. Customer owned outside plant (OSP) cabling.

PART 2 - PRODUCTS

2.1 PERMITTED BACKBONE MEDIA

A. Cables allowed for use in the backbone include:
   1. CAT 6A F/UTP Riser, Blue, Data – Siemon 9A6R4-A5-06-R1A
   2. CAT 6A F/UTP Plenum, Blue, Data – Siemon 9A6P4-A5-06-R1A
   3. 50 Pair Category 3 Riser Cable Gray – General Cable 2133161 or equal
   4. 50 Pair Category 3, OSP Rated PE-89, Black, 22 AWG – General Cable 7525637 or equal.
   5. Building Entrance Terminal, 50-Pair, 110 Style Termination – Circa 1880ECA1-50
   6. Fiber Optic Cable, Single-mode, 24 Strand, Armored Indoor/Outdoor Cable, Black – Siemon 9BG8P024L-E201A
   7. Fiber Optic Cable, Single-mode, 24 Strand, Armored, Plenum Cable, Yellow – Siemon 9BC8P024L-E205A
   8. Fiber optic Cable, Single-mode, 48 Strand, Armored Outdoor Cable, Black – Siemon 9PF8C048G-E201A
   9. Fiber Optic Cable, Single-mode, 144 Strand, Armored Outdoor Cable, Black – Siemon 9PF8C144G-E201A
   10. Fiber Optic cable, multi-mode, OM4, 12 Strand, Armored, Riser Cable, Aqua – Siemon 9BC5R012G-T512A (Data Centers must be OM4 or better)
   11. Microfiber
B. The cable shall support voice, data and imaging applications. The bending radius and pulling strength requirements of all backbone cables shall be observed during handling and installation.
C. Multi-pair twisted pair cable is intended to support analog voice applications and shall be tested for continuity only.

D. In addition to meeting the applicable performance specifications, all copper and optical fiber cables shall be appropriate for the environment in which it is installed.

2.2 MEDIA PRODUCTS

A. COPPER
1. The total channel length between the Campus Distributor/Main Cross-connect and to any floor Distributor/Horizontal Cross-connect shall not exceed the following length limits for copper cabling:
a. 2,000 m (6,560 ft) for balanced twisted pair for PBX/Class A (100 kHz) applications.
b. 200 m (656 ft) for balanced twisted pair for Class B (≤ 1 MHz) applications.
c. 100 m (328 ft) for balanced twisted-pair categories 6, 6A & 7 (per Backbone segment when providing a two-level Backbone).

B. MULTIMODE OPTICAL FIBER
1. See Siemon website for supportable fiber distances
a. Laser qualified 50/125 m multimode fiber optical fiber cables shall be following the following standards ISO/IEC 11801:2002 OM3, ANSI/TIA-568-C.3, ANSI/TIA-568-C.1 and Telcordia GR-409-CORE as well as the guaranteed application distances, attenuation, bandwidth, and group index requirements of refraction.
b. Specifications:
1) Shall support 10GBASE-SX for all horizontal workstations, risers and short length backbone (<300 m) locations.
2) Constructed for overfilled launch (OFL) and restricted mode launch (RML) bandwidth to ensure compatibility with both LED and laser light sources.
3) Have an Aqua Outer Jacket and be available in cable ratings including OFNR and OFNP.

C. SINGLE MODE OPTICAL FIBER
1. See Siemon website for supportable fiber distances
2. Single-mode optical fiber cable shall be used for 1st and 2nd Level Backbone applications only.
3. All fiber is to fusion spliced terminations.

PART 3 - EXECUTION

3.1 TOPOLOGY

A. The Backbone cabling shall use a conventional hierarchal star topology.
1. There shall be no more than two (2) levels of cross-connects between the campus distributor/main cross –connect (CD/MC) and any given floor distributor/horizontal cross-connect (FD/HC).
2. From the FD/HC no more than one cross-connect shall be passed through to reach the CD/MC.

B. Splicing of UTP, F/UTP and S/FTP copper cables is not permitted.

3.2 TYPICAL TDR BACKBONE

A. A typical TDR backbone for a hospital campus shall consist of:
1. Redundant (2 ea.) 24 strand single-mode fiber each routed in a separate path.
2. One 50 pair copper feed line.

END OF SECTION

SECTION 271500

HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
B. Section 27 05 28 - Pathways for Communications Systems

1.2 SUMMARY

A. This section includes requirements and guidelines for the installation of F/UTP, ScTP, and Fiber horizontal cabling.
   1. Horizontal cable and its connecting hardware provide the means of transporting signal between the telecommunications outlet/connector and the horizontal cross-connect located in the communications termination room This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.

PART 2 - EXECUTION

2.1 HORIZONTAL CABLE

A. Quantity
   1. Two horizontal cables shall be routed to each work area. Cable connected to information outlets shall be CAT6A F/UTP, 4-pair, 100Ω balanced twisted-pair.
      a. A work area is approximately 100 sq. ft. and includes the components that extend from the telecommunications outlet/connectors to the station equipment.
      b. Two (2) standard cables shall be run to each wireless access point location per current best practice.
      c. One (1) standard horizontal cable may be run to the following locations:
         1) Each building control system enclosure as directed by the building controls vendor.
         2) Each IP Video Surveillance Camera at each of the designated locations.
         3) Each wall phone.
         4) Each wall monitor/display.
   2. For voice or data applications, 4-pair balanced twisted-pair or fiber optic cables shall be run using a star topology from the telecommunications room serving that floor to every individual information outlet. The customer prior to installation of the cabling shall approve all cable routes.
   3. Installation interfaces shall be T568B wiring standards.
B. Maximum Length
   1. All horizontal cables, regardless of media type, shall not exceed 90 m (295 ft.) from the telecommunications outlets in the work area to the Floor Telecommunications Room.
   2. Distributor/Horizontal Cross connect (FD/HC) located in the Telecommunication Room.
   3. The combined length of jumpers, patch cords inclusive of equipment cables in the Floor Distributor/Horizontal Cross-connect shall not exceed 5m (16 ft.).
   4. The maximum length of Work Area equipment cables shall be 5m (16 ft.) If a

MuTOA (Multiple User Telecommunication Outlet) environment exists, then the maximum equipment cable shall not exceed 22m (72 ft.) (Lake Park Facility)

5. Terminate all conductors; no cable shall contain un-terminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.

C. Minimum Length
1. It is recommended that a minimum horizontal cable distance of 15m (49 ft.) shall be maintained between the telecommunications room and the work area. This will provide adequate Insertion Loss/Attenuation for applications over 1 Gig.
2. For installations with consolidation points, a minimum horizontal cable distance of 15m (49 ft.) shall be maintained between the telecommunications room and consolidation point, and 5m (16 ft.) between the consolidation point and the work area. This will provide adequate Insertion Loss/Attenuation for applications over 1 Gig.

D. Splice Free
1. Each run of balanced twisted-pair cable between Floor Distributor/Horizontal Cross-connect in the telecommunication room and the information outlet at the Work Area shall not contain splices.
2. Bridged taps and splices shall not be installed in the horizontal cabling.

E. Protection
1. Horizontal distribution cables shall not be run in under slab raceways that are damp or wet locations unless suitably rated for the environment.
a. Under slab conduits that are outside of the building are considered wet locations.

F. Slack -Service Loop – Routing
1. In the work area, a minimum of 1m (3 ft) should be left for balanced twisted-pair cables and fiber cables.
2. In telecommunications rooms a minimum of 3m (10 ft) of slack should be left for all cable types. This slack must be neatly managed on trays or other support types.

2.2 SEPARATION

A. Separation from EMI sources
1. Installation shall comply with BICSI TDMM and TIA/EIA-569-B for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and EMI Source shall be as follows:
a. EMI Source Rating Less Than 2 kVA: A minimum clearance of 5 inches.
b. EMI Source Rating between 2 and 5 kVA: A minimum clearance of 12 inches.
c. EMI Source Rating More Than 5 kVA: A minimum clearance of 24 inches.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or EMI Source shall be as follows:
a. EMI Source Rating Less Than 2 kVA: A minimum clearance of 2-1/2 inches.
b. EMI Source Rating between 2 and 5 kVA: A minimum clearance of 6 inches.
c. EMI Source Rating More Than 5 kVA: A minimum clearance of 12 inches.
4. Separation between communications cables in grounded metallic raceways and power lines and EMI Source located in grounded metallic conduits or enclosures shall be as follows:
a. EMI Source Rating Less Than 2 kVA: A minimum clearance of 2 inches.
b. EMI Source Rating between 2 and 5 kVA: A minimum clearance of 3 inches.
c. EMI Source Rating More Than 5 kVA: A minimum clearance of 6 inches.
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or 1 HP and Larger: A minimum clearance of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum clearance of 5 inches

B. Other Clearances
1. Horizontal pathways used for telecommunications cabling shall be dedicated for telecommunications use and not shared by other building services.
2. In a false ceiling environment, a minimum of 75 mm (3 in) shall be observed between the cable supports and the false ceiling.

2.3 PATHWAY

A. Cable Tie Wraps
1. Cable Tie Wraps are not permitted as a pathway device or support.
2. Tie Wraps shall only be used to provide strain relief at termination points.
3. Tie wraps shall not be over tightened to the point of deforming or crimping the cable sheath.

B. Constraints
1. Horizontal cables shall be installed in "dry" locations that provide protection from moisture levels above the intended operating range of inside plant (ISP) cables.
a. If cabling is intentionally or unintentionally exposed to water or otherwise coated with or exposed to direct contact with solvents, paints, adhesives, sealants or other third-party materials, Siemon will not warranty the cabling product or if after the warranty has been issued, it would become void. Therefore, any cabling that has been exposed as listed above, must be removed and replaced.
2. Horizontal pathways shall be installed or selected such that the minimum bend radius of horizontal cables is kept within manufacturer specifications both during and after installation.
3. A minimum of a 1" diameter conduit is required for new construction. Existing conduits will require the reduction of the number of cables placed in the conduit to meet the required fill ratio.
a. The Contractor shall observe the bending radius and pulling strength requirements of the 4-pair balanced twisted-pair and fiber optic cable during handling and installation.
1) 4-Pair UTP, F/UTP, S/FTP bend radius = 4 times outside diameter of cable under no-load conditions. 8 times the outside diameter under load (pulling 110 N/25 lbf.) conditions.
2) Multi-pair or Hybrid cable bend radius = 10 times the outside diameter under all conditions.
3) 2-Fiber and 4 Fiber cables bend radius = 25mm (1 in.) under no-load conditions. 50mm (2 in.) under load (pulling 222 N 50 lbf)
4. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
5. Cable that passes through non-Intermountain Health spaces must be installed in conduit.
6. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
7. Do not install bruised, kinked, scored, deformed, abraded cable or otherwise damaged cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. During Cold-Weather Installation, bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.

C. Capacity
1. The number of horizontal cables placed in a cable support or pathway shall be limited to the number of cables that will not alter the geometric shape of the cables.
2. Maximum pathway (cable tray/basket tray/wireway) capacity shall not exceed a calculated fill ratio of 50% to a maximum of 75 mm (3 in) inside depth.

3. Maximum conduit pathway capacity shall not exceed 40% fill. However, perimeter and furniture fill are limited to 60% fill for moves and changes. A 40% fill ratio is the maximum fill for CAT6A F/UTP cables.

Cable Tray Size [W x D] mm (in.)	Cable O.D. - CAT 6A Shielded (.29 in.)		
	7.4mm (0.29 in.)	8.4mm (0.33 in.)	8.9mm (0.35 in.)
304x101 (12 x 4)	363	280	249
457x101 (18 x 4)	545	20	374
610x101 (24 x 4)	726	561	498
304x152 (12 x 6)	545	420	374
457x152 (18 x 6)	817	631	561
610 x 152 (24 x 6)	1099	841	748

4. All unused cables shall be removed
   a. Or labeled at both ends designating future purpose and locations of each end.

END OF SECTION

SECTION 271513

COPPER CABLE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 PALLETTE

A. Color palette shall be in accordance with Section 27 05 53

1.3 SUMMARY

A. This Section covers approved F/UTP / UTP cable types
B. All systems except for Nurse Call shall be CAT6A F/UTP unless a written deviation has been approved.
C. CAT6A UTP and CAT6A F/UTP shall not be mixed on the same campus.
D. This cable shall be used for both voice and data applications and shall be plenum rated where required by code
E. All Nurse Call cables shall be CAT6 UTP.

PART 2 - PRODUCT

2.1 APPROVED PRODUCT

A. TYPE 6A F/UTP (foil over unshielded twisted pair) - Siemon
   1. CAT 6A F/UTP Riser, (CMR) – Siemon 9A6R4-A5-(XX)-R1A
   2. CAT 6A F/UTP Plenum, (CMP) – Siemon 9A6P4-A5-(XX)-R1A
      a. (XX) = Color – 06, Blue – 05, Yellow – 09, Orange
B. TYPE 6 UTP (unshielded twisted pair) – Siemon – Nurse Call only
   1. CAT 6 UTP Riser, (CMR) – Siemon 9C6R4-E3-09-RXB
   2. CAT 6 UTP Plenum, (CMP) – Siemon 9C6P4-E3-09-RXA

END OF SECTION

SECTION 271543

FACEPLATES AND CONNECTORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITION

A. Work-Area Cabling
   1. The work area is comprised of work area outlet/connectors, faceplates, outlet boxes and equipment cords. It acts as the interface to the horizontal cabling from the horizontal cross-connect (HC) to telephone, network equipment, wireless access points (WAP) and OIP devices.

PART 2 - PRODUCT

2.1 OUTLETS

A. Category 6A Shielded Jack – Siemon Z6A-S(XX)
   1. Use (XX) to specify color.
   2. Universal design allows the same outlet to be mounted in a flat or angled orientation.
B. UltraMAX Category 6 Jack – Orange – Nurse Call – Siemon U6-H09NS
C. Category 6A Z-Plug WO Latch Protector – Siemon ZP1-6AS-(00)s
D. Voice Outlet, Single Gang Faceplate, White W/Wall Hung Phone W/6A Insert – Siemon MX-WP-Z6AS-SS

2.2 FACEPLATES/BOXES

A. 10G Single Gang Faceplate, White, 4 Position – Siemon 10GMX-FP-04-02
B. MAX Single Gang Faceplate, White – Siemon MX-FP-S-(XX)-02
   1. USE (XX) to specify the number of ports.
C. MAX Single Gang Faceplate, Stainless Steel, 4 Position, with Label Holder – Siemon MX-FP-S-04-SS-L
   1. To be used in the Operation Rooms
D. Surface Mount Box, White, 2 Position – Siemon MX-SMZ2-02
E. Furniture Faceplate, Black – Siemon MX-UMA-01
F. Blank Insert, White – Siemon MX-BL-02
G. Blank Insert, Black – Siemon MX-BL-01
H. Conference Room Table Inserts shall include an HDMI port.

PART 3 - EXECUTION

3.1 WORK AREA TERMINATION

A. All balanced twisted-pair cables wired to the telecommunications outlet/connector, shall have 4-pairs terminated in eight-position modular outlets in the work area. All pairs shall be terminated.
B. Outlet/connector back boxes shall be a minimum 4-11/16 square box (4-11/16” x 4-11/16” x 3”) with a minimum single gang 5/8” mud ring for new construction to accommodate the CAT6A connectors.

C. All outlets need to be installed in the angled position.

END OF SECTION

SECTION 271619

PATCH CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. This section is issued as a guide for patch cable installations in the Data Center, wiring closets (TDR) and user areas where patch cables are required for connectivity to IP and TDM phones, and IP data connectivity needs for Intermountain Healthcare. All patch cables will support voice, data, and imaging applications within the Intermountain Healthcare Enterprise.

PART 2 - PRODUCTS

2.1 APPROVED PRODUCT

A. Patch Cable, CAT 6A Shielded Skinny- Siemon SP6A-S (XX)-(XX)
   1. Use 1st (xx) to specify length. Use 2nd (xx) for color.

B. Patch Cable, CAT 6, Orange – Siemon MC6-(XX)-09-28
   1. Use (xx) to specify length. For use with NURSE CALL only.

C. Patch Cable, Fiber, Single mode Duplex W/LC Connectors, Yellow – Siemon FJ2-LCULCUL-(xx)
   1. Use (xx) to specify length.

D. Patch Cable, Fiber, Multimode Duplex W/LC Connectors, Aqua – Siemon FJ2-LCLC5V-(xx)AQ
   1. Use (xx) to specify length. For use in the Data Center.

PART 3 - EXECUTION

3.1 PALLETTE

A. Patch Cable Color Codes
   1. The Intermountain Healthcare Enterprise standard for patch cable color is in Section 27 05 53.
   2. The patch cable color shall match the feed cable color to identify the service provided.

B. Contractor furnished.
   1. All patch cables for the TEC, TDRs shall be included in the low voltage contract and will be required to match or exceed the existing level of the installed structured cabling system.
   2. All patch cables for the user areas shall be Owner furnished and will be required to match or exceed the existing level of the installed structured cabling system.
   3. All patch cables shall be Owner installed.
   4. The quantity of patch cables provided by the low voltage contractor shall be specified in the plans.
      a. 50% 5ft – 40% 7ft – 5% 10ft – 5% 15ft

END OF SECTION

SECTION 27 41 33
MASTER ANTENNA TELEVISION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Master antenna television systems using direct broadcast satellite service or community cable as the signal source. Provide broadband coaxial cabling for distributing television signal to user interface outlets.

1.3 DEFINITIONS

A. Broadband: For the purposes of this Section, wide bandwidth equipment or systems that can carry signals occupying in the frequency range of 54 to 1002 MHz. A broadband communication system can simultaneously accommodate television, voice, data, and many other services.

B. Carrier: A pure-frequency signal that is modulated to carry information. In the process of modulation, it is spread out over a wider band. The carrier frequency is the center frequency on any television channel.

C. CATV: Community antenna television; a communication system that simultaneously distributes several different channels of broadcast programs and other information to customers via a coaxial cable.

D. dBmV: Decibels relative to 1 mV across 75 ohms. Zero dBmV is defined as 1 mV across 75 ohms. dBmV = 20 log $10(V_1/V_2)$ where V_1 is the measurement of voltage at a point having identical impedance to V_2 (0.001 V across 75 ohms).

E. Headend: The control center of the master antenna television system, where incoming signals are amplified, converted, processed, and combined into a common cable along with any locally originated television signals, for transmission to user-interface points. It is also called the "Central Retransmission Facility."

F. RF: Radio frequency.

G. TV Outlet: End point of Contractor's responsibility for Work of this Section. TV outlets are the 75-ohm terminals on device plates.

1.4 SYSTEM DESCRIPTION

A. System shall consist of direct broadcast satellite service from the existing headend through a new coaxial cable distribution system.

B. Headend processing equipment shall be owner provided.

C. Distribution of community television service signals. This will include coordinating with Owner's selected service provider for processing the signals as needed to provide specified services combined into a single-feed point ready for connection into the distribution system. Obtain signal levels, and noise and distortion characteristics from service provider as the point of departure for system layout and final equipment selection.

D. Cable distribution system consisting of coaxial cables, user interfaces, directional signal taps and splitters, RF amplifiers, signal equalizers, power supplies, and required hardware complying with IEEE 802.7 and resulting in performance parameters specified in this Section. System shall be capable of distributing television channels as follows, according to EIA 542:

1. 12 VHF Channels and FM: 2 through 6 low-band VHF, FM band; and 7 through 13 high-band VHF.
2. 60 CATV Channels 2 through YY (61) low, mid, high, super, and ultra band.

E. Hardware Requirements: Use modular, plug-in, solid-state electronic components. Install amplifiers and other powered equipment on plywood backboards installed in the designated TDR locations.

1.5 PERFORMANCE REQUIREMENTS

A. Minimum acceptable distribution system performance at all user-interface points shall be as follows:

1. RF Video Carrier Level: Between 2 and 10 dBmV.
2. Relative Video Carrier Level: Within 3 dB to adjacent channel.
3. Channel Frequency Response: Across any 6-MHz channel in 54- to 220-MHz frequency range, referenced to video, signal amplitude shall be plus or minus 1 dB, maximum.
4. Carrier-to-Noise Ratio: 45 dB or more.
5. RF Visual Signal-to-Noise Ratio: 43 dB or more.
6. Cross Modulation: Less than minus 50 dB.
7. Terminal Isolation from Television to Television: 25 dB, minimum.
8. Hum Modulation: 2 percent, maximum.

1.6 SUBMITTALS

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

B. Shop Drawings: Show fabrication and installation details for television equipment.

1. Include plans, elevations, sections, details, and attachments to other work.
2. For coaxial cable, include the following installation data for each type used:

a. Nominal OD.
b. Minimum bending radius.
c. Maximum pulling tension.

3. Functional Block Diagram: Show single-line interconnections between components for headend and distribution system to user-interface points. Show cable types and sizes.
4. Dimensioned plan and elevations of headend equipment. Show access and workspace requirements.
5. Wiring Diagrams: Power, signal, and control wiring; and grounding.
6. Design Calculations: Calculate signal attenuation budget and show calculated line and equipment losses for the system based on the functional block diagram, to show that proposed system layout can be expected to perform up to specification. Allowable losses between components and User Interface shall be used to determine size and type of coaxial cable.

C. Equipment List: Include every piece of equipment by model number, manufacturer, serial number, location, and date of original installation. Add testing record of each piece of adjustable equipment, listing name of person testing, date of test, and description of as-left set points.

D. Source quality-control test reports on coaxial cable sweep tests.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For headend and distribution system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Lists of spare parts and replacement components recommended to be stored at the site for ready access.
2. Include dimensioned plan and elevation views of components and enclosures. Show access and workspace requirements.

G. Samples: Full size, for each outlet and finish plate, for colors and textures required.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NECA 1.

C. Comply with NFPA 70.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: System components shall be equipped and rated for the environments where installed.

1.9 COORDINATION

A. Coordinate size and location of raceway system, and provisions for electrical power to equipment of this Section.

B. Coordinate Work of this Section with requirements of Owner’s selected service provider.

1.10 EXTRA MATERIALS

A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Provide no fewer than one of each item listed below. Deliver extra materials to Owner.

1. Fuses: One for every 10; each type and rating.
2. Splitters: One for every 10 installed.
3. MATV Distribution Power Amplifiers: One for every 10; each type installed.
4. MATV Signal Traps: One for every 10; each type used.
5. MATV Attenuators: One for every 10; each type used.
6. Cable: 100 feet; each type used.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SYSTEMS REQUIREMENTS

A. Components: Modular plug-in, heavy-duty, industrial- or commercial-grade units.

B. Equipment: Silicon-based, solid-state, integrated circuit devices.

C. Power Supply Characteristics: Devices shall be within specified parameters for ac supply voltages within the range of 105 to 130 V.

D. Protect signal cables and connected components against transient-voltage surges by suppressors and absorbers designed specifically for the purpose. Comply with Division 26 Section "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits."

E. Provide ac-powered equipment with integral surge suppressors, complying with UL 1449.

F. RF and Video Impedance Matching: Signal-handling components, including connecting cable, shall have end-to-end impedance-matched signal paths. Match and balance devices used at connections where it is impossible to avoid impedance mismatch or mismatch of balanced circuits to unbalanced circuits.

2.3 MATV EQUIPMENT

A. Description: Signal-source components and amplifying equipment, distribution components, and interconnecting wiring. System shall receive signals from sources, amplify and process them, and distribute them to outlets for receiving sets.

B. MATV System Quantitative Performance Requirements: Level and quality of signal at each outlet from each designated channel and source shall comply with Specifications below when tested according to 47 CFR 76.

2.4 MATV DISTRIBUTION COMPONENTS

A. Manufacturers:

1. Blonder Tongue Laboratories, Inc.
2. Channel Master, Inc.
3. Motorola Broadband Communications Sector.
4. Pico Macom

B. Distribution Equipment: Broadband amplifier and combining networks for receiving television signals and outputting the signals to cable distribution system.

C. Broadband Amplifier:

1. Frequency Range: 54 to 750 MHz.
2. Frequency Response: Plus or minus 1.0 dB across passband.
3. Maximum Noise: 10 dB.
4. Minimum Return Loss: 16 dB.
5. I/O Impedance: 75 ohms.

2.5 DISTRIBUTION COMPONENTS

A. Manufacturers:

1. Blonder Tongue
2. Channel Master
3. Motorola Broadband Communications Sector.
4. Pico Macom

B. Distribution components shall be for signal processing and distribution downstream from headend equipment.

C. Signal Splitters and Isolation Taps: Metal-enclosed directional couplers with brass connector parts.

1. Return Loss: 17 dB.
2. RFI Shielding: 100 dB.
3. Isolation: 25 dB.
4. Impedance: 75 ohms for input and output terminals.
5. Electrically powered components shall be UL labeled.

D. Signal Traps: Packaged filters tuned to interference frequencies encountered in Project.

E. Attenuators: Passive, of fixed value, used to balance signal levels.

F. Terminating Resistors: Enclosed units rated 0.5 W and matched for coaxial impedance.

G. User-Interface Device (TV Outlets): Flush, female-type outlets for mounting in standard outlet box, with metallic parts of anodized brass, beryllium copper, or phosphor bronze.

1. Cable Connector: Female, Type F.
2. Wall Plates: Match materials and finish of power outlets in same space.
3. Attenuation: Less than 0.1 dB.
4. Voltage Standing-Wave Ratio: Less than 1.15 to 1.

2.6 CABLES

A. Manufacturers:

1. Alpha Wire Company.
2. Belden Inc.; Electronics Division.
3. Coleman Cable.
4. CommScope Properties, LLC.
5. West Penn Wire/CDT; a division of Cable Design Technologies, Inc.

B. Cable Characteristics: Broadband type, recommended by cable manufacturer specifically for broadband MATV applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB minimum from 7 to 806 MHz, and shall be listed to comply with NFPA 70, Articles 810 and 820.

C. RG-6/U, Plenum-Rated Indoor Distribution Cable (Horizontal Drop): No. 16 AWG, solid bare copper conductor; gas-injected foam-PE insulation. Double shielded with 100 percent aluminum-foil shield, 60 percent aluminum braid. Copolymer jacket. NFPA 70, Type CATV and UL 910.

D. RG-11/U, Plenum-Rated Indoor Distribution Cable (Trunk): No. 14 AWG, solid bare copper conductor, gas-injected foam-PE insulation. Double shielded with 100 percent aluminum foil shield, 60 percent aluminum braid. Copolymer jacket. NFPA 70, Type CATV and UL 910.

2.7 CABLE CONNECTORS

A. Manufacturers:

1. Amphenol Corporation.
2. B&L Coaxial Connections, Ltd.
3. Connect-Tech Products.
4. Leviton Voice & Data Division.

B. MATV Coaxial Cable Connectors: Type F, 75 ohms.

2.8 SOURCE QUALITY CONTROL

A. Cable products shall be sweep tested at the factory before shipping at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pathway elements intended for coaxial cable installation. Check raceways, cables, trays, and other elements for compliance with accessibility for installation and maintenance, and other conditions affecting installation.

B. Examine roughing-in for antenna to verify actual locations of cable connections before antenna installation.

C. Examine walls, floors, roofs, equipment bases, and roof supports for suitable conditions where television equipment is to be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Wiring Method: Install cables in raceways except in accessible indoor ceiling spaces, attics and as otherwise indicated. Conceal raceways and wiring except in unfinished spaces.

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

C. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

D. Grounding: According to recommendations in IEEE 142 and IEEE 1100.

3.3 COAXIAL CABLE INSTALLATION

A. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps may not be used for heating.

B. Cable may not be installed in same raceway with power cable.

C. Coaxial cable shall not be spliced except on plywood backboards in wire closets, or in cabinets designated for the purpose.

D. Outdoor connections shall be installed in enclosures meeting NEMA 250, Type 4X. Connectors shall be corrosion resistant with properly designed O-rings to keep out moisture.

E. Do not use water-based cable pulling lubricants with PVC-jacketed cable.

F. Do not exceed manufacturer's recommended minimum bending radiuses

G. Pulling Cable: Do not exceed manufacturer's recommended pulling tensions. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

H. Exposed Cable: Install parallel to building lines, follow surface contours, and support cable according to manufacturer's written instructions. Do not run adjacent and parallel to power or data cables.

I. Cable Support: Install supports at intervals recommended in writing by cable manufacturer. Install supports within 6 inches of connector so no weight of cable is carried by connector. Use no staples or wire ties, pull tie-wrap snug, and do not over tighten.

J. Signal Equalization: Where system performance may be degraded in certain operating modes, revise component connections and install distribution amplifiers and attenuators as required, providing a balanced signal across the system.

K. Install passive circuit devices, such as splitters and attenuators, in wire closets or cabinets. Do not install attenuators as part of user-interface device outlets.

3.4 EQUIPMENT INSTALLATION

A. Mount distributed equipment as recommended by manufacturer. Group related items in methodical sequence.

B. Arrange equipment to facilitate access for maintenance and to preserve headroom and passage space. Parts that require periodic service or maintenance shall be readily accessible. Headend components that require tuning adjustments shall be accessible from the front of equipment cabinets.

C. Antenna Cable Entrance (If required): Use entrance fittings, seal, and waterproof penetrations of the building envelope.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals according to Division 26 Section "Identification for Electrical Systems."

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.

B. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.

C. Pretesting: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements. Replace malfunctioning or damaged items. Retest until satisfactory performance and conditions are achieved. Prepare television equipment for acceptance and operational testing as follows:

1. Use an agile receiver and signal strength meter or spectrum analyzer for testing.
2. CATV Sources: Connect receiver to an agile demodulator or CATV set-top converter at CATV service entrance to the facility.

D. Test Schedule: Schedule tests after pretesting has successfully been completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.

E. Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.

F. Distribution System Acceptance Tests:

1. Field-Strength Instrument: Rated for minus 40-dBmV measuring sensitivity and a frequency range of 54 to 812 MHz, minimum. Provide documentation of recent calibration against recognized standards.
2. Signal Level and Picture Quality: Use a field-strength meter or spectrum analyzer, and a standard TV receiver to measure signal levels and check picture quality at all TV outlets.

    a. Test the signal strength in dBmV at 55 and 750 MHz.
    b. Minimum acceptable signal level is 0 dBmV (1000 mV).
    c. Maximum acceptable signal level over the entire bandwidth is 12 dBmV.
    d. Television receiver shall show no evidence of cross-channel intermodulation, ghost images, or beat interference.

G. Qualitative and Quantitative Performance Tests: Demonstrate reception quality of color-television program transmissions at each user interface from each designated channel and source. Quality shall be equal to or superior than that obtained with performance checks specified below, using a standard, commercial, cable-ready, color-television receiver. Level and quality of signal at each outlet and from each designated channel and source shall comply with the following Specifications when tested according to 47 CFR 76:

1. RF video-carrier level.
2. Relative video-carrier level.
3. Broadband frequency response.
4. Channel frequency response.
5. Carrier-to-noise ratio.
6. RF visual signal-to-noise ratio.
7. Cross modulation.
8. Terminal isolation.
9. Hum modulation.

H. Record test results.

I. Retest: Correct deficiencies identified by tests and observations and retest until requirements specified in Part 1 are met.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain MATV equipment.

1. Train Owner's maintenance personnel on procedures and schedules for troubleshooting, servicing, and maintaining equipment.
2. Demonstrate methods of determining optimum alignment and adjustment of components and settings for system controls.

3. Demonstrate programming and tuning of satellite receivers.
4. Refer to Division 01 Section "Demonstration and Training."

B. Conduct a minimum of four hours' training as specified in instructions to Owner's employees in Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 275113

OVERHEAD PAGING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Primary Division 27 subcontractor shall be accountable to closely coordinate the Overhead Paging system with the General Contractor.
   1. Division 27 is accountable for including the cabling, equipment, and installation thereof in their work; based upon the project drawings.

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

C. Requirements of the following Division 26 Sections apply to this Section:
   1. Basic Electrical Requirements.
   2. Basic Electrical Materials and Methods.

1.2 SUMMARY

A. This Section includes the installation of an overhead paging system that shall be accessible through the telephone system. It includes requirements for paging system components including, but not limited to, the following:
   1. Speaker systems.
   2. Wiring

B. This section requires that rough-in materials for this section be provided by the Division 26 installer for installation under Division 26. Rough-in materials include but are not limited to conduit, junction boxes, alternative raceway, and device enclosures. Cable for this section is to be provided by the Division 27 installer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following (for each type of product) as listed in the drawings and these specifications:
   1. BiAmp – (Vocia)

2.2 SYSTEM REQUIREMENTS

A. General: Provide complete and fully functional overhead paging systems using materials and equipment of types, sizes, ratings, and performances as indicated. Use materials and equipment that comply with referenced standards and manufacturers' standard design and construction in accordance with published product information. Coordinate the features of materials and equipment so they form an integrated system with components and interconnections matched for optimum performance of specified functions.

2.3 EQUIPMENT AND MATERIALS

A. General: Provide all solid-state components fully rated for continuous duty at the ratings indicated or specified. Select equipment for normal operation on input power supplied at 105-130 V, 60 Hz.

B. Loudspeakers shall be Drop-In Tile speakers. To be 24” x 24” tile speakers, provided by one of the following manufactures.
   1. Bogen CSD2X2/VR
   2. Quam System 12/70RS

C. Transformer must be capable of providing 25V/70V.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with the Installer present, for compliance with requirements and other conditions affecting the performance of the Overhead Paging System work.
B. Do not proceed until unsatisfactory conditions have been corrected.
C. Verify compliance of the following items before beginning sound equipment installation.
   1. No cables spliced except at standard barrier terminal blocks inside equipment cabinet.
   2. Cables marked at each end with permanent wire labels such as Brady or equal.
   3. Isolated ground run back to main electrical panel from paging equipment cabinet.
   4. Specified conduit, cables, speaker enclosures and equipment cabinets are properly installed.

3.2 INSTALLATION

A. General: Install system in accordance with NFPA 70 and other applicable codes. Install equipment in accordance with manufacturer's written instructions.
B. Speakers:
   1. Confirm polarity of speaker before installation and wire to maintain uniform polarity.
   2. Mount transformers with screws securely to speaker brackets or enclosures.
   3. Neatly mount speaker grilles, panels, connector plates, etc., tight, plumb, and square unless indicated otherwise on drawings.
   4. Provide brackets, screws, adapters, springs, rack mounting kits, etc., recommended by manufacturer for correct assembly and installation of speaker assemblies and electronics components.
   5. Identification:
      a. Legibly identify user operated system controls and system input/output jacks using engraved, permanently attached laminated plastic plates or imprinted Lexon labels. Label equipment and controls within equipment cabinet using similar labels or "Kroy" type labels.
C. Repairs: Wherever walls, ceilings, floors, or other building finishes are cut for installation, the contractor shall be responsible to repair, restore, and refinish to original appearance.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Provide services of a factory authorized service representative to supervise the field assembly and connection of components and the pre-testing, testing, and adjustment of the system.
B. Pre-testing: Upon completing installation of the system, align, adjust, and balance the system and perform a complete pretest. Determine the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed. Replace malfunctioning or damaged items with new, and retest until materials satisfactory performance and conditions are achieved.

3.4 COMMISSIONING

A. Occupancy Adjustments: When requested by the Architect or the Sound/Acoustical Consultant within one year of date of substantial completion, provide on-site assistance in adjusting sound levels, resetting matching transformer taps, and adjusting controls to suit actual occupied conditions. Provide two trips for this purpose.

3.5 CLEANING AND PROTECTION

A. Prior to final acceptance, clean system components and protect from damage and deterioration.

END OF SECTION

SECTION 27 51 17
NETWORKED PUBLIC ADDRESS AND PAGING SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the installation of a new networked public address and overhead paging system. It includes requirements for Biamp VOCIA Networked PA system components including, but not limited to, the following:
   1. Amplifier modules
   2. Speakers
   3. Wiring System
   4. Programming

B. Related Requirements:
   1. "Raceways", for raceways used for overhead paging system cables.
   2. "Electrical Boxes and Fittings", for boxes, cabinets, and fittings used with overhead paging systems.

1.3 SYSTEM DESCRIPTION

A. General: The networked public address paging system shall be a complete system for delivering audio signals to distributed programmable amplifier modules via the facility's Ethernet network. Input from the telephone system to the network as the paging system source will need to be coordinated to provide a SIP trunk connection.

B. Functional Performance: Components and system features and functions shall include, but are not limited to, the following:
   1. Meet the following performance parameters as measured in 1/3 octave bands:
      a. From 100 Hz to 2kHz, flat within plus or minus 2dB.
      b. Above 2kHz, slope down along an approximate 3dB octave slope to 8kHz.
   2. When driven to maximum output, clipping shall first occur in power amplifiers.
   3. No noise, hum, RFI pickup or distortion shall be audible under normal operating conditions.
   4. The overhead paging system shall reproduce program material at a level of 85 dBA without audible distortion.

1.4 ACTION SUBMITTALS

A. Product data for each type of product specified.

B. Shop drawings detailing equipment layout elevations and specific installation requirements.

C. Wiring Diagrams detailing wiring for power, signal, and control, differentiating clearly between manufacturer installed wiring and field installed wiring. Identify terminal numbers and wiring color codes to facilitate installation, operation, and maintenance.

D. System operation description of the telephone audio/zone selection communication to the paging system.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who is a factory authorized sales and service representative of those manufacturers specified to perform the work of this Section. Refer to Division 1 Section "Definitions and Standards" for definition of experienced Installer. Upon request, submit evidence of such qualifications to the specifying authority.

B. Electrical Component Standard: Provide work complying with applicable requirements of NFPA 70 "National Electrical Code."

C. EIA Compliance: Comply with the following Electronics Industries Association Standards:
1. Sound Systems, EIA 160.2.
2. Loudspeaker, Dynamic Magnetic Structures, and Impedance, EIA 299 A.
3. Racks, Panels, and Associated Equipment, EIA 310 A.
4. Amplifiers for Sound Equipment, SE 101 A.
5. Speakers for Sound Equipment, SE 103.
6. Microphones for Sound Equipment, SE 105.
7. UL Compliance: Comply with requirements of UL 50.

D. Coordination of Work: Coordinate the Work of this Section with the requirements of the Owner's paging system technicians and perform the following:
1. Pre-Installation Meeting: Meet jointly with the representatives of the Owner, to exchange information and agree on details of installation interfaces, current system operations including zone identification and classification, and any other circumstances that impact on the completion of the work of this Section.
2. Record agreements reached in the meeting and distribute the record to the other participants.

1.6 WARRANTY REQUIREMENTS

A. In addition to the requirements of Division 1 and other sections of this specification, provide complete warranty repair or replacement for a minimum of one year after date of substantial completion at no cost to owner, except in the case of obvious abuse

B. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

C. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement of rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty.

D. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.

E. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.

F. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.
   1. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

G. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following (for each type of product) as listed in the drawings and these specifications:
   1. Biamp VOCIA.
   2. Atlas Sound (Speakers only)
   3. Bogen (Speakers only)
   4. Lowell (Speakers only)

2.2 SYSTEM REQUIREMENTS

A. General: Provide complete and fully functional networked public address and paging systems using materials and equipment of types, sizes, ratings, and performances as indicated. Use materials and equipment that comply with referenced standards and manufacturers' standard design and construction in accordance with published product information. Coordinate the features of materials and equipment so they form an integrated system with components and interconnections matched for optimum performance of specified functions.

2.3 EQUIPMENT AND MATERIALS

A. General: Provide all solid state components fully rated for continuous duty at the ratings indicated or specified. Select equipment for normal operation on input power supplied at 105 130 V, 60 Hz.

B. Programmable Amplifier Modules: Provide the Biamp VOCIA VA-8600C as indicated in the drawings.

C. Loudspeakers shall be a 8" dual cone type with a 10 ounce, ceramic magnet. Power handling rating shall be 5 watts continuous with a sensitivity of 94 dB at 1 meter/1 watt and frequency response of +/- 5 dB from 80 to 15,000 Hz. The speaker shall have an impedance of 8 ohms

with no 70V transformer required. Recessed ceiling mounted speaker assemblies shall mount on an Atlas Sound 51-8 or similar baffle on an EZ-95-8 series or similar enclosure. Provide the Atlas Sound C10A speaker (or equivalent) for general purpose locations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with requirements and other conditions affecting the performance of the Networked Public Address and Paging System work.

B. Do not proceed until unsatisfactory conditions have been corrected.

C. Verify compliance of the following items before beginning sound equipment installation.

D. No cables spliced except at standard barrier terminal blocks inside equipment cabinet.

E. Cables marked at each end with permanent wire labels such as Brady or equal.

F. Isolated ground run back to main electrical panel from paging equipment cabinet.

G. Specified conduit, cables, speaker enclosures and equipment cabinets are properly installed.

3.2 INSTALLATION

A. General: Install system in accordance with NFPA 70 and other applicable codes. Install equipment in accordance with manufacturer's written instructions.

B. Speakers:
1. Confirm polarity of speaker before installation and wire to maintain uniform polarity.
2. Neatly mount speaker grilles, panels, connector plates, etc., tight, plumb, and square unless indicated otherwise on drawings.
3. Provide brackets, screws, adapters, springs, rack mounting kits, etc., recommended by manufacturer for correct assembly and installation of speaker assemblies and electronics components.
4. Speakers shall be connected in a series-parallel methodology as indicated in the drawings. An impedance bridge will be required to read all speaker loops as they are terminated to the amplifier modules. Amplifier loss due to incorrect impedances shall be the responsibility of the Installer.

C. Amplifier Modules:
1. Assure sufficient ventilation for adequate cooling of equipment.
2. Securely fasten equipment plumb and square in place according to manufacturer recommendations.
3. Connect powered components to 120 VAC outlets on transient voltage surge suppressor.
4. Cables:
   a. Leave sufficient service loops of uniform length.
   b. Do not parallel or branch cables and lines except at standard barrier terminal blocks using the provided phoenix connectors. Label all branch wiring.
   c. Secure cables to equipment cabinet with wire ties to ensure neat installation. Do not use double-stick tape or sticky-back cable anchors.

D. Repairs: Wherever walls, ceilings, floors, or other building finishes are cut for installation, repair, restore, and refinish to original appearance.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Provide services of a factory authorized service representative to supervise the field assembly and connection of components and the pre-testing, testing, and adjustment of the system.

B. Pre-testing: Upon completing installation of the system, align, adjust, and balance the system and perform complete testing. Determine the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pre-testing. Replace malfunctioning or damaged items with new, and retest until materials satisfactory performance and conditions are achieved.

3.4 COMMISSIONING

A. Occupancy Adjustments: When requested by the Architect or the Engineer within one year of date of substantial completion, provide on site assistance in adjusting sound levels, zone assignments, and adjusting controls to suit actual occupied conditions. Provide one trip for this purpose.

3.5 CLEANING AND PROTECTION

A. Prior to final acceptance, clean system components and protect from damage and deterioration.

END OF SECTION

SECTION 27 52 23
NURSE CALL/CODE BLUE SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Specification Section 27 00 00 "Intermountain Healthcare Structured Cabling Standards".

1.2 SUMMARY

A. Section includes raceways, back boxes and cabling for a Hill-Rom Navicare Nurse Call (NNC) system.

B. All active components and software to be provided, installed and programmed by Hill-Rom Vendor under contract with the owner.

PART 2 - PRODUCTS

2.1 NURSE-CALL SYSTEM:

A. Nurse-Call System: Hill-Rom Navicare Nurse Call (NNC) System. All electronic components

2.2 CONDUCTORS AND CABLES

A. Data Cable and Hardware: Category 6, Orange, UTP and UTP hardware. Comply with requirements in Section 270000.

B. Power Conductors and Cables: Copper, solid, No. 20 AWG. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

C. Grounding Conductors and Cables: Copper, stranded, No. 16 AWG. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Wiring Method:
   1. Install cables in raceways and J-Hooks except within consoles, cabinets, desks, and counters
      a. Conceal raceway and cables except in unfinished spaces.
   2. Conduit and Boxes: Comply with requirements in Section 26 05 33 "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.
      a. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.
      b. Coordinate each outlet box type with Hill-Rom.

B. Install cables without damaging conductors, shield, or jacket.

C. Do not bend cables, while handling or installing, to radii smaller than as recommended by manufacturer.

D. Pull cables without exceeding cable manufacturer's recommended pulling tensions.
   1. Pull cables simultaneously if more than one is being installed in same raceway.
   2. Use pulling compound or lubricant if necessary. Use compounds that will not damage conductor or insulation.
   3. Use pulling means, including fish tape, cable, rope, and basket-weave wire or cable grips, that will not damage media or raceway.

E. Install exposed raceways and cables parallel and perpendicular to surfaces or exposed structural members, and follow surface contours. Secure and support cables by straps, staples, or similar fittings designed and installed so as not to damage cables. Secure cable at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, or fittings.

F. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

G. Separation of Wires: Separate speaker/microphone, line-level, speaker-level, and power-wiring runs. Run in separate raceways or, if exposed or in same enclosure, provide 12-inch (300-mm) minimum separation between conductors to speaker/microphones and adjacent parallel power and telephone wiring. Provide separation as recommended by equipment manufacturer for other conductors.

H. Splices, Taps, and Terminations: Make splices, taps, and terminations on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Install terminal cabinets where there are splices, taps, or terminations for eight or more conductors.

I. Impedance and Level Matching: Carefully match input and output impedances and signal levels at signal interfaces. Provide matching networks if required.

J. Identification of Conductors and Cables: Comply with requirements in Section 271500 "Communications Horizontal Cabling" for cable administration, cable schedule, and cable and wire identification.

K. Equipment Identification:
1. Comply with requirements in Section 260553 "Identification for Electrical Systems" for equipment labels and signs and labeling installation requirements.
2. Label stations, controls, and indications using approved consistent nomenclature.

3.2 EXISTING SYSTEMS

A. Examine existing systems for proper operation, compatibility with new equipment, and deficiencies. If discrepancies or impairments to successful connection and operation of interconnected equipment are found, report them and do not proceed with installation until directed. Schedule existing systems' examination so there is reasonable time to resolve problems without delaying construction.

3.3 GROUNDING

A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other signal impairments.

B. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding except at connection to main building ground bus.

C. Grounding Provisions: Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.
1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

END OF SECTION

SECTION 275319

INTERNAL CELLULAR, PAGING AND ANTENNA SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
B. Requirements of the following Division 26 Sections apply to this Section:
   1. Basic Electrical Requirements.
   2. Basic Electrical Materials and Methods.

1.2 SUMMARY

A. The DAS system is provided and installed as an Owner-provided, Owner installed (OFOI) system by a 3rd-party vendor, contracted and managed by Intermountain CTIS/Telecom Team.
B. A/E to coordinate DAS requirements with the Owner's vendor to incorporate necessary infrastructure on their drawings to support all fully functional DAS system.

PART 2 - EXECUTION

2.1 INSTALLATION

A. DAS contractor is to install their equipment located in the TDRs in the assigned Rack location as noted in the ET TDR Room Elevation Drawings.
B. DAS contractor is to install any wall mounted equipment in the TDRs in the assigned location as noted in the ET TDR Room Elevation drawings.
C. Specific power requirements will need to be provided in the design phase of the project by the CTIS/Telecom team.
D. Cable installation will follow Division 27 installation specifications.
E. The fiber DAS distribution shall be installed in a star topology from the DAS room to all TEC/TDR's.

END OF SECTION

SECTION 276001

APPENDIX 01 – DEVIATION REQUEST PROCESS

PART 1 - GENERAL

1.1 DEFINITIONS

A. Cable Plant Deviation
   1. A business deviation to not fully comply with the requirements of the "Division 27 – Communications and Structured Cabling Specification document"

B. Cable Plant Deviation Request form.
   1. The document is available from the Facilities Planning team, the Data Center Ops team, or the Infrastructure Cabling team.
   2. Usage:
      a. The deviation request form shall be used if there is a business need to not comply with the requirements of the "Division 27 – Communications and Structured Cabling Specification document."
      b. The deviation request form should also be used to propose a change to that document. Always verify that you are using the current version of the Standard before requesting a modification.

PART 2 - PROCESS

2.1 STANDARDS MODIFICATION

A. Check the box and explain why the standard should be modified.

2.2 ALTERNATE PRODUCT

A. The deviation form must be completed, submitted through channels, and approved prior to any deviation from the specifications. This includes issuing change orders.

2.3 AUTHORIZED SIGNATURES

A. Both the Standards Holder and the DCO Manager signatures are required for a deviation to be valid.

2.4 DEVIATION REVIEW PROCESS STEPS

A. First be sure that there is an actual need. Then be certain that your manager, supervisor, or project manager agrees with the requested deviation. Be sure to state this or obtain their signature on the deviation form. By doing so you are confirming that your supervisor or project manager has approved.

B. The requestor will then complete sections 1, 2, and 3 of the deviation form.
   1. The requestor should then digitally sign in the designated location at the end of Section 3. Do not write in the sections below 3.

C. Forward the saved copy of this form to the Standards Holder via email.
   1. Email to: melissa.lopez2@imail.org

D. The Standards Holder will then review and evaluate the request. The requestor should be prepared to provide plans, specifications, and competitive bids if requested. Any email threads or meeting discussions regarding the issue will be taken into consideration.

E. The Standards Holder will then cast an Approve or Deny vote and forward the request to the DCO Manager for a decision.

F. When the decision has been made by the DCO Manager, the Standards Holder will then notify the requester by returning the completed and signed form via email.

G. An approved deviation will have the final disposition button 'Approved' and be signed by at least 2 people. One will be from the Standards Holder, and the other the DCO Manager. Other signatures may be required for specific features and areas such as Safety, Security, Print, Medical group, etc.

H. The deviation request is only good for the specific project that it was submitted on. A change to Division 27 is required for the deviation to be in place moving forward on all future projects.

PART 3 - EXECUTION

3.1 POST DECISION EXECUTION

A. DENIED

1. If the requester is not satisfied with the decision, they may file an appeal with the Data Center Operations manager (shawn.folkman@imail.org), who will then escalate the issue to the appropriate business leaders as needed. The decision from the appeal is final.

B. APPROVED

1. If a deviation is approved for contracted material, labor, or method; the facilities project manager will arrange for fulfillment or contract adjustment as needed via appropriate contract channels such as change orders.

END OF SECTION

SECTION 276002

APPENDIX 02 – DOCUMENT REFRESH PROCESS

PART 1 - GENERAL

1.1 **NOT USED**

PART 2 - PRODUCTS

2.1 **APPROVED PRODUCT**

A. The purpose of this section is to help ensure a current standards document.
B. The product delivered will be a current revision or version of the Cable Plant Standards Document.
C. All changes must be approved by the Enterprise Infrastructure Cabling team.

PART 3 - EXECUTION

3.1 **REVIEWS AND UPDATES**

A. Minor updates
1. Changes that do not significantly affect scope of work, or contract pricing will be made, and the Rev number will be updated. (i.e. updated part numbers, etc.)
2. Significant changes will be added to the Change Log for review and approval from the DCO/Infrastructure Cabling Team.
a. When approved, they will be implemented in the new Version.

B. Major updates
1. The DCO/Infrastructure Cabling Team will review the entire document at least once every three years.
2. This review will coincide with the release of new versions of NFPA70 (National Electrical Code) (2017, 2020, etc. - to be completed by the end of each designated year).
3. The review will cover standards adjustments that may be deemed necessary and ensure compliance with applicable codes and standards.
4. Upon completion of the reviews and updates, the standards document will be submitted for approval.

END OF SECTION

Model	Manufacture	Part Number	Description	Notes
Eaton Single-Phase UPS				
5S UPS	Eaton	5S550	550VA/330W, 120V Line Interactive UPS	
9PX UPS	Eaton	9PX1000RT	1000VA/900W, 120V Online UPS, RM or Tower	
9PX UPS	Eaton	9PX1500RTN	1500VA/1350W, 120V Online UPS, RM or Tower, Includes NETWORK-M3 Card	
9PX UPS	Eaton	9PX2000RTN	2000VA/1800W, 120V Online UPS RM, or Tower, Includes NETWORK-M3 Card	
9PX UPS	Eaton	9PX3000RTN	3000VA/2700W, 120V Online UPS RM, or Tower, Includes NETWORK-M3 Card	
9PX UPS	Eaton	9PX3K3UNP1	3000VA/2700W, 208/240V to 120V Online UPS, RM or Tower, Includes NETWORK-M3 Card	
Bypass Option 9PX 1-3kVA	Eaton	9PXEBM72RT	EBM for use with 9PX2000RTN & 9PX3000RTN UPS	
Network Card option 9PX 1-3K	Eaton	NETWORK-M3	Eaton Gigabit Network Card	
Rack mount kit 9PX 1-3kVA Option	Eaton	RK2PC	2-post rack mounting kit for 1-6kVA UPS & EBM	
9PX SP UPS	Eaton	9PX6KSP	5500VA/4900W, 120/208 or 120/240V Split-Phase Online UPS, RM or Tower, Includes NETWORK-M3 Card	
Model	**Manufacture**	**Part Number**	**Description**	**Notes**
9PX SP UPS	Eaton	9PX8KSP	8000VA/7200W, 120/208 or 120/240V Split-Phase Online UPS, RM or Tower, Includes NETWORK-M3 Card	

9PX SP UPS	Eaton	9PX10KSP	10000VA/9000W, 120/208 or 120/240V Split-Phase Online UPS, RM or Tower, Includes NETWORK-M3 Card	
Bypass 9PX SP 6-10kVA, 9PXM	Eaton	BPM125HW	Bypass Power Module for 6, 8 &10kVA 9PX Split-Phase, 9PXM & 9155 UPS, Hardwired Input/Ouput	
9PXM UPS	Eaton	9PXM8S8K	8kVA expandable to 16kVA, (1) 8-slot enclosure, (2) power modules, (4) battery modules, (1) network card, Hardwired Input/Output	
9PXM UPS	Eaton	9PXM8S12K	12kVA expandable to 16kVA, (1) 8-slot enclosure, (3) power modules, (6) battery modules, (1) network card, Hardwired Input/Output	
9PXM UPS	Eaton	9PXM8S16K	16kVA, (1) 8-slot enclosure, (4) power modules, (8) battery modules, (1) network card, Hardwired Input/Output	
9PXM UPS	Eaton	9PXM12S12K	12kVA expandable to 20kVA N+1, (1) 12-slot enclosure, (3) power modules, (6) battery modules, (1) network card, Hardwired Input/Output	
Model	**Manufacture**	**Part Number**	**Description**	**Notes**
9PXM UPS	Eaton	9PXM12S16K	16kVA expandable to 20kVA N+1, (1) 12-slot enclosure, (4) power modules, (8) battery modules, (1) network card, Hardwired Input/Output	
9PXM UPS	Eaton	9PXM12S20K	20kVA expandable to 20kVA N+1, (1) 12-slot enclosure, (5) power modules, (10) battery modules, (1) network card, Hardwired Input/Output	

PDU's				
Smart PRO1 PDU	Server Tech	C1C10SA-2CBA2B4	Smart Primary PRO1 PIPS PDU, 1U, (10) HDOT Outlets (6xC13 + 4xCx), Input Amp Meter, 208V 30A, NEMA L6-30P, 10 ft (3m) Input Cord, Circuit Breakers, (2) Temperature/Humidity Sensor Capable	Horizontal
Smart POPS PRO2 PDU	Server tech	C2SG36TE-DQME2M66/ZB	Smart POPS Primary PRO2 (36) Alt Phase HDOT Outlets (24xC13 + 12xCx), 208V 3PH Delta 6BR 60A, IP67 Water-tight IEC60309 3m/10ft cord, Auto-Orient Mid Display, Bottom Cord Entry, Doghouse Breakers, Phase Monitoring, Blue Highlights	Vertical
Smart POPS PRO2 PDU	Server tech	C2LG36TE-DQME2M66/ZR	Smart POPS Expansion PRO2 (36) Alt Phase HDOT Outlets (24xC13 + 12xCx), 208V 3PH Delta 6BR 60A, IP67 Water-tight IEC60309 3m/10ft cord, Auto-Orient Mid Display, Bottom Cord Entry, Doghouse Breakers, Phase Monitoring, Red Highlights	Vertical
Model	**Manufacture**	**Part Number**	**Description**	**Notes**
Smart POPS PRO2 PDU	Server Tech	C2SG36TE-DCMFAM66/C	Smart POPS Master PRO2 (36) Alt Phase HDOT Configurable Outlets, 208V 3PH Delta 3BR 30A L15-30P 3m/10ft cord, Auto-Orient Mid Display, Bottom Base Cord Entry, Doghouse Breakers, Phase Monitoring, WxD = 2.20in x 2.50in	Notes
Smart PRO1 PDU	Server Tech	C1S24VS-YCFA13C9/C	Smart PRO1 Primary, 0U, 18 x IEC C13 and 6 x IEC C19 Outlets, 1 x NEMA 5-20R Utility Outlet, 3 x LED Amp Meters, 3-phase Wye 30A Input w/ NEMA L21-30P Connector, 10ft (3m) Cord (Bottom/base Entry), (2) Temperature/Humidity Sensor Capable, with Retractable Fuses	Vertical

Smart PRO1 PDU	Server Tech	C1L24VS-YCFA13C9/C	Smart PRO1 Expansion, 0U, 18 x IEC C13 and 6 x IEC C19 Outlets, 1 x NEMA 5-20R Utility Outlet, 3 x LED Amp Meters, 3-phase Wye 30A Input w/ NEMA L21-30P Connector, 10ft (3m) Cord (Bottom/base Entry), (2) Temperature/Humidity Sensor Capable, with Retractable Fuses	Vertical
Smart PRO1 PDU	Server Tech	STV-3531C	Smart PRO1, PIPS (Per Input Power Sensing), 0U, (24) IEC C13 + (6) IEC C19 Outlets, (1) LED Current Meter w/ Auto-flip, 208-240V 30A, NEMA L6-30P Plug, 10 ft (3m) Cord w/ Power Pivot Cord Entry, Middle Display/Network, (2) Temperature/Humidity Sensor Capable, Circuit Breakers	Vertical
Model	**Manufacture**	**Part Number**	**Description**	**Notes**
Smart PRO1 PDU	Server Tech	SEV-3531C	Smart PRO1 (Expansion Unit), PIPS (Per Input Power Sensing), 0U, (24) IEC C13 + (6) IEC C19 Outlets, (1) LED Current Meter w/ Auto-flip, 208-240V 30A, NEMA L6-30P Plug, 10 ft (3m) Cord w/ Power Pivot Cord Entry, Middle Display/Network, (2) Temperature/Humidity Sensor Capable, Circuit Breakers	Vertical
MN03E1R0-10D203-2TL5A0H10-S	Vertiv/Geist PDU	NI30202	Unit-level monitored PDU, 20A, 120V, rackmount, 10x rear NEMA 5-20R receptacles	Horizontal
MNR3E1R6-12CF18-3TL6A0H10-S	Vertiv/Geist PDU	NR30206	12-Outlets PDU - Monitored - NEMA L6-30P - 12 x Combination C13/C19 - 230 V AC - Network (RJ-45) - Horizontal - Rack-mountable - Horizontal	Horizontal
MN03E4W1-44MB19-3TL21A0B10-S	Vertiv/Geist PDU	VP8865	rPDU, Monitored Unit Level EC, 30A, 120/208V WYE, 8.6kW, Vertical, (36) IEC	Vertical

			C13, (6) IEC C19, (2) NEMA 5-20R, 10ft power cord with L21-30P, Black Powder Coat.	
ePDU	Eaton	EMIT06-10	Metered Input ePDU, 208V, 5.76 Max. kW, L6-30P Input (10ft), (10) C13, (4) C19 Output, 1U	
ePDU	Eaton	EMIT09-10	Metered Input ePDU, 120V, 1.92 Max. kW, L5-20P (5-20P adapter) Input (10ft), (8) 5-20R Output, 1U	
Model	**Manufacture**	**Part Number**	**Description**	**Notes**
T- Sensor ePDU	Eaton	EMPDT1H1C2	Environmental Monitoring Probe Gen 2	
eATS	Eaton	EATS120	Rack Mount Automatic Transfer Switch, Non-phase Synchronized Switching Compatible, 120V, 1.92 Max. kW, (2) 5-20P (10ft) Input, (10) 5-20R Output, 1U	
eATS	Eaton	EATS30P	Rack Mount Automatic Transfer Switch, Non-phase Synchronized Switching Compatible, 208V, 5.76 Max. kW, (2) L6-30P (10ft) Input, (1) L-6-30R Output, 1U	
Power Cords				
Dual Lock Power Cord	StayOnline Power Cords	5656N	IEC320 C14 Male Plug to C13 Connector Dual-Lock 1.8 meters / 6 feet 10A/250V 18/3 SVT Red - Locking Power Cord	
Dual Lock Power Cord	StayOnline Power Cords	6694N	IEC320 C14 Male Plug to C13 Connector Dual-Lock 1.8 meters / 6 feet 10A/250V 18/3 SVT Blue - Locking Power Cord	
Dual Lock Power Cord	StayOnline Power Cords	5914N	IEC320 C20 Male Plug to C19 Connector Dual-Lock 1.8 meters / 6 feet 20A/250V 12/3 SJT Red - Locking Power Cord	

Dual Lock Power Cord	StayOnline Power Cords	6766N	IEC320 C20 Male Plug to C19 Connector Dual-Lock 1.8 meters / 6 feet 20A/250V 12/3 SJT Blue - Locking Power Cord	
NEMA to IEC Power Cord	StayOnline Power Cords	9008	NEMA 5-15 Male Plug to IEC320 C13 Connector 1.8 meters / 6 feet 15A/125V 14/3 SJT Red - Power Cord	
Model	**Manufacture**	**Part Number**	**Description**	**Notes**
NEMA to IEC Power Cord	StayOnline Power Cords	7978	NEMA 5-15 Male Plug to IEC320 C13 Connector 1.8 meters / 6 feet 15A/125V 14/3 SJT Blue - Power Cord	
P-Lock Power Cord	StayOnline Power Cords	9144	IEC320 C14 Male Plug to C15 Connector P-Lock 1.8 meters / 6 feet 15A/250V 14/3 SJT Red - Locking Power Cord	
P-Lock Power Cord	StayOnline Power Cords	9138	IEC320 C14 Male Plug to C15 Connector P-Lock 1.8 meters / 6 feet 15A/250V 14/3 SJT Blue - Locking Power Cord	
Mechanical				
VRC	Vertiv		3.5kW Rack Mounted Cooling Unit	VRC100 (Self Contained Version)
Mini-Mate 3	Liebert	MT036HE1A00XCH	Ceiling mounted thermal management system, direct expansion unit.	
Mini-Mate 4	Liebert	MT048HE1A00AP4	Ceiling mounted thermal management system, direct expansion unit.	
Mini-Mate 5	Liebert	MT060HE1A00WPZ	Ceiling mounted thermal management system, direct expansion unit.	
Mini-Mate 3	Liebert	MMD40C2AJ0D5	Ceiling mount chilled water unit	
Mini-Mate 5	Liebert	MMD92CDAJ0L5	Ceiling mount chilled water unit	

CRV	Liebert	CR020RA1A70A71	Row-Based Environmental Control System, DX direct expansion 5 ton Unit	
Model	**Manufacture**	**Part Number**	**Description**	**Notes**
CRV	Liebert	CR035RA1A70A71	Row-Based Environmental Control System, DX direct expansion 10 ton Unit	
CRV	Liebert	CR032RC1A2SH	Row-Based Environmental Control System, Chilled water 5 ton unit	
CRV	Liebert	CR040RC1A2SH	Row-Based Environmental Control System, Chilled water 10 ton unit	
Cable Ladder Tray				
Cable Runway	CHATSWORTH	10250-724	CABLE RUNWAY - 24", BLACK WITH ALL REQUIRED MOUNTING ACCESSORIES	
Cable Runway	CHATSWORTH	10250-718	CABLE RUNWAY - 18", BLACK WITH ALL REQUIRED MOUNTING ACCESSORIES	
Butt Splice	CHATSWORTH	11301-701	BUTT SPLICE KIT, Black	
Junction Splice	CHATSWORTH	11302-701	JUNCTION SPLICE KIT	
Foot kit	CHATSWORTH	11309-701	FOOT KIT, BLACK	
Rack to Runway	CHATSWORTH	12409-724	6" CHANNEL RACK TO RUNWAY, BLACK	
Triangle Bracket	CHATSWORTH	11746-718	18" TRIANGLE BRACKETS, BLACK	
Triangle Bracket	CHATSWORTH	11746-724	24" TRIANGLE BRACKETS, BLACK	
End Closing Kit	CHATSWORTH	11700-724	END CLOSING KIT, CABLE RUNWAY, BLACK	
Wall Angle Support Kit	CHATSWORTH	11421-718	18" WALL ANGLE SUPPORT KIT, CABLE RUNWAY, BLACK	
Model	**Manufacture**	**Part Number**	**Description**	**Notes**

Wall Angle Support Kit	CHATSWORTH	11421-724	24" WALL ANGLE SUPPORT KIT, CABLE RUNWAY, BLACK	
Elevation Kit	CHATSWORTH	10506-706	CABLE RUNWAY ELEVATION KIT, 6"	
Radius Drop	CHATSWORTH	12100-712	CABLE RUNWAY RADIUS DROP	
DC Fiber modules & Jumpers				
Wall Mount Module Box	SIEMON	**WMF-A-01**	Wall Mount Module Box, OM4 Aqua, LC/MTP	
Wall Mount Module Box	SIEMON	**WMF-B-01**	Wall Mount Module Box, OM4 Violet, LC/MTP	
Fiber Patch Cable	SIEMON	**LBP-LCULCUL-(XX)**	PATCH CABLE LBP, FIBER, SINGLEMODE DUPLEX W/LC CONNECTORS, YELLOW, (XX) = LENGTH IN METERS	
Fiber Patch Cable	SIEMON	**LBP-LCLC5V-(XX)AQ**	PATCH CABLE LBP, FIBER, MULTIMODE DUPLEX W/LC CONNECTORS, AQUA, (XX) = LEGTH IN METERS	
Fiber Patch Cable	SIEMON	**LBP-LCLC5V-(XX)EQ**	PATCH CABLE LBP, FIBER, MULTIMODE DUPLEX W/LC CONNECTORS, ERIKA VIOLET, (XX) = LEGTH IN METERS	
Foreseer Cable, 2 Pair	Belden	88723		
Cold/Hot aisle containment provided by Data Center Operations				
Electronic Key Cylinders				
Cylinder	Medeco	100500 G	1 ¼" Mortise Cylinder	
Cylinder	Medeco	100400H G	Rim Cylinder, Horizontal Tailpiece	
Cylinder	Medeco	EA-100108	Small Format Interchangeable Core (SFIC) Cylinder	
Model	**Manufacture**	**Part Number**	**Description**	**Notes**
Cylinder	Medeco	20200S1 G	Cylinder Package for Schlage	
Cam Lock	Medeco	EN-150002-219	7/8" Cam Lock Assembly, Key Retaining	
Cam Lock	Medeco	EN-150003-219	1 1/8" Cam Lock Assembly, Key Retaining	
Cylinder for Legrand cabinet front door	Medeco	232301S 800 G	Modular Profile Cylinder – 30mm Half Profile - Assembled	

Electronic Key	Medeco	94-0271	Medeco Slim Line Key (G2) & Charger Bundle	
Programming Station for Small Locations	Medeco	EA-100109	Medeco XT Desktop USB Programming Station (not preferred)	
Programming Station for Large Locations	Medeco	EA-100158	Medeco XT Wall USB Programming Station (preferred)	
Wall Mount for Wall Programmer	Medeco	94-0294	Medeco XT Remote Wall Programmer Wall Mount Kit	
Padlock	Master	6842D045KZ	Padlock for use with Electronic Cylinder	

SECTION 276004

APPENDIX 04 – REFERENCE STANDARDS

PART 1 - GENERAL

1.1 **REFERENCE STANDARDS**

A. Codes and Standards (Most recent editions with addenda/TSB, etc.) All materials, installation and workmanship shall meet or exceed the applicable requirements and standards addressed within the references listed below:

1. ANSI/TIA-568.0-D and addenda "Generic Telecommunications Cabling for Customer Premises
2. ANSI/TIA-568.1-D and addenda "Commercial Building Telecommunications Cabling Standard
3. ANSI/TIA-568.2-D and addenda "Balanced Twisted-Pair Telecommunications Cabling and Components
4. ANSI/TIA-568.3-D and addenda "Optical Fiber Cabling Components Standard"
5. ANSI/TIA-568.4-D and addenda "Broadband Coaxial Cabling and Components Standard"
6. ANSI/TIA-569-D and addenda "Telecommunications Pathways and Spaces"
7. ANSI/TIA-606-C and addenda "Administration Standard for Commercial Telecommunications Infrastructure"
8. ANSI/TIA-607-D and addenda "Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises"
9. ANSI/TIA-758-B "Customer-Owned Outside Plant Telecommunication Infrastructure Standard"
10. IEEE 802.3at PoE Plus and Next Gen PoE CFI March 2013 and IEEE P802.3ba latest draft revision and amendments.
11. "Media Access Control Parameters, Physical Layers and Management Parameters for 40 Gbp/s and 100 Gbp/s Operation".
12. ANSI/TIA-526-7-A "Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant"
13. ANSI/TIA/EIA-526-14-C "Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant"
14. ANSI/TIA-942-B "Telecommunications Infrastructure Standard for Data Centers"
15. ANSI/TIA – 1179-A "Healthcare Facility Telecommunications Infrastructure Standard"
16. IEC/TR3 61000-5-2 - Ed. 1.0 and amendments "Electromagnetic compatibility (EMC) - Part 5: Installation and mitigation guidelines - Section 2: Earthing and cabling."
17. ISO/IEC 11801-1 (2017) and amendments "Information technology - Generic cabling for customer premises – PART 1: General Requirements"
18. EN 50173-1 and amendments "Information Technology - Generic cabling systems – PART 1 General Requirements"
19. AIA Guidelines for Design and Construction of Hospital and Healthcare Facilities
20. Construction Specification Institute Master Format
21. BICSI: Comply with the most current editions of the following BICSI manuals:
    a. BICSI - Telecommunications Distribution Methods Manual
    b. BICSI – Installation Transport Systems Information Manual
    c. BICSI – Network Design Reference Design Manual
    d. BICSI – Outside Plant Design Reference Manual
    e. BICSI – Wireless Design Reference Manual
    f. BICSI -Electronic Safety and Security Design Reference Manual

g. Infocomm/BICSI – AV Design Reference Manual

22. Underwriters Laboratories (UL) Cable Certification and Follow-Up Program.
23. National Electrical Manufacturers Association (NEMA)
24. American Society for Testing Materials (ASTM)
25. National Electrical Code (NEC) NFPA70 2020
26. National Electrical Safety Code (NESC) 2017
27. Institute of Electrical and Electronic Engineers (IEEE)
28. UL Testing Bulletin
29. Building Industry Consulting Services International (BICSI) Information Transport Systems Methods Manual (ITSMM)
30. Local, county, state and federal regulations and codes in effect as of date of installation.
31. Equipment of foreign manufacture must meet U.S. codes and standards. It shall be indicated in the proposal the components that may be of foreign manufacture, if any, and the country of origin.

END OF SECTION

SECTION 276005

APPENDIX 05 – DEFINITIONS AND ABBREVIATIONS

PART 1 - GENERAL

1.1 **RELATED TERMS**

A. Codes and Standards (Most recent editions with addenda/TSB, etc.) All materials, installation and workmanship shall meet or exceed the applicable requirements and standards addressed within the references listed below:

1. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
2. BICSI: Building Industry Consulting Service International.
3. CBC: Coupled Bonding Conductor
4. CFCI: Customer Furnished Customer Installed
5. Cable Run - A single cable to a single location
6. Cable Drop - Two cables to a single location
7. Cable Tri Drop - Three cables to a single location.
8. CT Coupler A type of wall connector made by the Siemon Company
9. DCO: Data Center Operations
10. Div.1: Division 1 General and Performance Requirements
11. Div. 23: Division 23 Heating, Ventilating, and Air Conditioning
12. Div. 22: Division 22 Plumbing
13. Div. 26: Division 26 Electrical
14. Div. 27: Division 27 Communications and Audio Visual
15. Div. 28: Division 28 Electronic Safety and Security
16. E.E.: Electrical Engineer
17. EMI: Electromagnetic Interference
18. F/UTP: Foil over Unshielded Twisted Pair. Individual pairs are unshielded.
19. GC: General Contractor
20. GE: Ground Equalizer
21. Horizontal Cabling: The cable and connecting hardware utilized to transport communications signals.
22. ICT: Infrastructure Cabling Team
23. LAN: Local Area Network
24. N/A: Not Applicable
25. NIC: Not in Contract
26. OFCI: Owner Furnished Contractor Installed
27. OFOI: Owner Furnished Owner Installed
28. OTDR: Optical Time Domain Reflectometer
29. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
30. RCDD: Registered Communications Distribution Designer
31. RFI: Radio Frequency Interference
32. TBA or TBD: To Be Determined
33. TDR: Technology Distribution Room
34. TEC: Technology Equipment Center
35. TGB: Telecommunications Ground Bus Bar
36. TMBC: Telecommunications Main Bonding Conductor
37. TMGB: Telecommunications Main Grounding Bus Bar
38. TSER: Telecommunications Service Entrance Room
39. UTP: Unshielded Twisted Pair
40. Work Area: approx. 100 sq. ft. equipped for workstation equipment.

41. DCO = Data Center Operations – Boe.Sausedo@imail.org
42. ICT = Information and Communications Technology – Melissa.Lopez2@imail.org

END OF SECTION

SECTION 276006

APPENDIX 06 – MATERIAL SUPPLIERS

PART 1 - GENERAL

1.1 **RELATED TERMS**

A. Siemon Authorized Suppliers are listed below. To help prevent counterfeiting and support warranties, known, factory authorized distributers are recommended.
1. Approved Suppliers of Siemon cable, patch panels, jacks, and parts:

Wesco/Anixter

Randi Whittaker
Inside Sales
3775 W. California Ave. Ste 400
Salt Lake City, UT 84104 US
Main Phone: (801) 973-2121
Fax: (801) 973-4472
Email: randi.whittaker@anixter.com

Karl Bartlam
End User/Outside Sales
3775 W. California Ave. Ste 400
Salt Lake City, UT 84104 US
Main Phone: (801) 973-2121
Fax: (801) 973-4472
Email: karl.bartlam@anixter.com

Graybar Electric

Elizabeth Vaughn
Inside Sales
2841 South 900 West
Salt Lake City, UT 84119 US
Main Phone: (801) 656-3016
Fax: (801) 973-4314
Email: Elizabeth.Vaughn@graybar.com

Erika Morrison
Contractor Outside Sales
2841 South 900 West
Salt Lake City, UT 84119 US
Main Phone: (801) 656-3014
Fax: (801) 973-4314
Email: Erika.Morrison@graybar.com

WESCO / CSC

Brian Walters
Inside Sales
3210 South 900 West
Salt Lake City, UT 84119 US
Main Phone: (801) 975-0600
Fax: (801) 907-4450
Email: Bwalters@gocsc.com

Adam Tueller
Contractor Outside Sales
3210 South 900 West
Salt Lake City, UT 84119 US
Main Phone: (801) 975-0600
Direct: (801) 618-6665
Email: Atueller@gocsc.com

B. The Siemon Company is represented locally by: Easton_Jones@siemon.com

END OF SECTION

SECTION 276007

APPENDIX 07 – SIEMON CERTIFIED INSTALLATION FIRMS

PART 1 - GENERAL

1.1 **RELATED TERMS**

A. NOTE: Cable installers have rigorous requirements to be certified for Siemon cables and products. Validation of certification is required prior to accepting a bid.

B. The firms selected to bid must be pre-approved by the local facility IT manager. Installation firms desiring to do work for Intermountain Health must be selected from the official CI list below.

C. Current Siemon Approved/Certified Cable Installers for Siemon Network Cable. This list is up to date as of 2025-01-03.

1. **Orion Integration Group**: 8880 W. Barnes Street, Boise, ID 83709
   a. Greg Chavez // Phone 208 321 8000 / Fax 208 321 8555 / Direct 208 489 2230 // Gchavez@io-group.com / www.oi-group.com
2. **ACS Systems**: 925 North Main St. Meridian, ID 83642
   a. Doug McCleery // Phone 208 331 8554 / Fax 208 884 5638 / Mobile 208 412 5763 // doug@acs-systems.com / www.acs-systems.com
3. **IES Commercial**: 16292 So. Bringhurst Boulevard, Suite 700, Bluffdale, UT 84065
   a. Brad Davis – Branch Manager // Phone 801 975 8182 / Fax 385 242 7366 / Mobile 385 448 7175 // Brad.Davis@iescomm.com / www.iescomm.com
4. **Cache Valley Electric**: 1338 S. Gustin Rd., Salt Lake City, UT 84104
   a. Travis Grant – Acct. Manager // Phone 801 908 4170 / Fax 801 908 7401 Mobile 801 870 7226 // Travis.Grant@cve.com / www.cve.com
   Brad Readicker – Acct. Manager // Phone 801 908 2686 / Fax 801 908 7401 Mobile 801 870 4963 // Brad.Readicker@cve.com / www.cve.com
5. **Hunt Electric, Inc**.: 1863 W. Alexander St., Salt Lake City, UT 84119
   a. Colton – Technology Division Manager // Phone 801 975 8844 Mobile 385 505 2662 // Colton. @huntelectric.com / www.huntelectric.com
6. **Linx**: 167 West 7065 South, Midvale UT 84047
   a. Mike Herd – Account Executive // Mobile 801 702 7083 // MHerd@teamlinx.com / www.teamlinx.com
   Steve Faddis – Project manager // Mobile 385 707 5168 // SFaddis@teamlinx.com / www.teamlinx.com
7. **Data Plus**: 769 Middlegate Road, Henderson, NV 89118
   a. Chris Tettamanti – Project Manager // Phone 702 795 3282 Chris@dpcnv.com
8. **Bombard Electric**: 4380 West post Road, Las Vegas, NV 89118
   a. Bob Reese – Project/Division Manager // Phone 702 263 3570 Bob.reese@bombardelec.com / www.bombardelectric.com
9. **Fisk Electric**: 6412 Arville Street, Las Vegas, NV 89118
   a. Anthony Sant – Operations Manager // Phone 702 435 5053 / Fax 702 435 2127 / Mobile 702 373 6969 // Asant@fiskcorp.com / www.fiskcorp.com
10. **Mojave Electric**: 3755 W. Hacienda Ave., Las Vegas, NV 89118
    Phone 702 798 2970

11. **The Morse Group**: 3874 Silvestri Lane, Las Vegas, NV 89120
    a. Chuck Sudberry – Group Manager Low Voltage // Phone 702 257 4452 Mobile 702308 4410 // Csudberry@themorsegroup.com/ www.themorsegroup.com
12. **Linx:** 9900 E 51st Ave., Denver, Co 80238
    a. John Lopez // Phone 303 500 2860 // JLopez@teamlinx.com
13. **TelNet Systems:** 547 S 20th Street West, Suite #2, Billings, MT 59102
    a. Clay Jensen // Phone 406 855 7478 // Clay.Jensen@telnetsystemsmt.com

END OF SECTION

SECTION 280500

COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Electronic safety and security equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout.
5. Common electronic safety and security installation requirements.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

A. Product Data: For sleeve seals.

1.5 COORDINATION

A. Coordinate arrangement, mounting, and support of electronic safety and security equipment:
1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Sleeves for Rectangular Openings: Galvanized sheet steel.
   1. Minimum Metal Thickness:
      a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
      b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

C. Fire-Rated Assemblies for Low Voltage Penetrations: Engineered prefabricated fire stop system. The acceptable manufacturers of firestop systems are:
   1. STI Firestop (EZ-Path)

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Metraflex Co.
      d. Pipeline Seal and Insulator, Inc.
   2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
   3. Pressure Plates: Carbon steel. Include two for each sealing element.
   4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electronic safety and security equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRONIC SAFETY AND SECURITY PENETRATIONS

A. Electronic safety and security penetrations occur when raceways, pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install listed firestop system from one of the acceptable manufacturer products listed below during construction of floor or wall at each point where communications cabling, cable tray, conduit, sleeves, etc., penetrate a fire-rated assembly. The acceptable manufacturers of firestop systems are:
1. STI EZ-Path

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants.".

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install engineered prefabricated fire rated assemblies.

K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

END OF SECTION 280500

SECTION 28 05 13
CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. UTP cabling.
2. 8.3/125 – 9/125 micrometer, singlemode optical fiber cabling.
3. Coaxial cabling.
4. RS-232 cabling.
5. RS-485 cabling.
6. Control-voltage cabling.
7. Control-circuit conductors.
8. Fire alarm wire and cable.
9. Identification products.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. IDC: Insulation displacement connector.

C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

D. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

E. RCDD: Registered Communications Distribution Designer.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate layout and installation of electronic safety and security cabling with Owner's telecommunications and LAN equipment and service suppliers.

B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Installation data for UTP and optical-fiber cables as specified in TIA 569-C-1.

2. For coaxial cable, include the following installation data for each type used:
   a. Nominal OD.
   b. Minimum bending radius.
   c. Maximum pulling tension.

B. Shop Drawings:
1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
3. Cabling administration drawings and printouts.
4. Wiring diagrams to show typical wiring schematics, including the following:
   a. Cross-connects.
   b. Patch panels.
   c. Patch cords.
5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: An NRTL.
1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.
1. Test optical-fiber cable to determine the continuity of the strand, end to end. Use optical loss test set.
2. Test optical-fiber cable on reels. Use an optical time domain reflectometer to verify the cable length, and locate cable defects, splices, and connector; include the loss value of each. Retain test data and include the record in maintenance data.
3. Test each pair of UTP cable for open and short circuits.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

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.

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels in Section 061000 "Rough Carpentry."

2.3 UTP CABLE

A. Manufacturer: Siemon

B. Description: 100-ohm, four-pair UTP, covered with a blue thermoplastic jacket.
1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA-568-C.1 for performance specifications.
3. Comply with TIA-568-C.2, Category 6A F\UTP.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
   a. Communications, Plenum Rated: Type CMP complying with NFPA 262.
   b.

2.4 UTP CABLE HARDWARE

A. Manufacturer: Siemon

B. UTP Cable Connecting Hardware: IDC type, using modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of the same category or higher.

C. Connecting Panels: 110-style for Category 6A F\UTP. Provide panel connectors for the number of cables terminated on the panel, plus 20 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

2.5 OPTICAL-FIBER CABLE

A. Manufacturer: Siemon

B. Description: Singlemode, 8.3/125 – 9/125 micrometer fiber, strands as noted, tight buffer, optical-fiber cable with interlocked armor jacket.
1. Comply with ICEA S-83-596 for mechanical properties.
2. Comply with TIA-568-C.3 for performance specifications.
3. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
   a. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
4.

C. Jacket:
1. Jacket Color: Yellow.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-C.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals.

2.6 OPTICAL-FIBER CABLE HARDWARE

A. Manufacturer: Siemon

B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

C. Patch Cords: Factory-made, dual-fiber cables in 36-inch lengths.

D. Cable Connecting Hardware: Comply with the Fiber Optic Connector Intermateability Standard (FOCIS) specifications of TIA-604-2-B, TIA-604-3-B, and TIA-604-12. Comply with TIA-568-C.3.
1. Quick-connect, simplex and duplex, Type LC connectors. Insertion loss not more than 0.75 db.

2.7 COAXIAL CABLE

A. Manufacturers: CommScope, Belden, Coleman, West Penn CDT

B. General Coaxial-Cable Requirements: Broadband type, recommended by cable manufacturer specifically for broadband data-transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 db maximum from 7 to 806 MHz.

C. RG-11/U (Plenum Rated): NFPA 70, Type CMP.
1. No. 14 AWG, solid, copper-covered steel conductor.
2. Gas-injected, foam-PE insulation.
3. Double shielded with 100 percent aluminum polyester tape and 60 percent aluminum braid.
4.
5. Suitable for outdoor installations in ambient temperatures ranging from minus 40 to plus 85 deg C.

D. RG-6/U (Plenum Rated): NFPA 70, Type CMP.
1. No. 18 AWG, solid, copper-covered steel conductor; foam fluorinated ethylene propylene insulation.
2. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.
3. Jacketed with PE.

E. NFPA and UL Compliance: Coaxial cables shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655 and with NFPA 70, Article 820 "Radio and Television Equipment" and Article 830 "Community Antenna Television and Radio Distribution Systems." Types are as follows:
1. CATV Plenum Rated: Type CATVP, complying with NFPA 262.

2.8 COAXIAL-CABLE HARDWARE

A. Coaxial-Cable Connectors:
1. Type BNC, 75 ohms, crimp on style.
2. Type F compression style for RG-6/U and RG-11/U cables.

2.9 RS-232 CABLE

A. RS-232 communications require three to nine conductors with an overall shield. Circuit is limited to a distance of not more than 50 feet (15 m). Add other conductor count cables as needed for the project.

B. Plenum-Rated Cable: NFPA 70, Type CMP.
1. No. 22 AWG, stranded (7x30) tinned copper conductors.
2. PE insulation.
3. Aluminum foil-polyester tape shield with 100 percent shield coverage.
4. Fluorinated ethylene propylene jacket.
5. Conductors are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
6. Flame Resistance: Comply with NFPA 262.

2.10 RS-485 CABLE

A. Plenum-Rated Cable: NFPA 70, Type CMP.
1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. Flame Resistance: NFPA 262, Flame Test.

2.11 CONTROL-VOLTAGE CABLE

A. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
1. One pair, twisted, No. 16 AWG, stranded (19x29) and No. 18 AWG, stranded (19x30)] tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

2.12 CONTROL-CIRCUIT CONDUCTORS

A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, complying with UL 83, in pathway.

B. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, complying with UL 83, in pathway.

C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or TF in pathway.

2.13 FIRE ALARM WIRE AND CABLE

A. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

2.14 CONSOLIDATION POINTS

A. Description: Consolidation points shall comply with requirements for cable connecting hardware.
1. Number of Terminals per Field: One for each conductor in assigned cables.
2. Number of Connectors per Field:
3.
a. One for each four-pair conductor group of indicated cables, plus 20 percent spare positions.
b.
4. NRTL listed as complying with UL 50 and UL 1863.
5. When installed in plenums used for environmental air, NRTL listed as complying with UL 2043.

2.15 IDENTIFICATION PRODUCTS

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.16 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test UTP and optical-fiber cables on reels according to TIA-568-C.1.

C. Factory test UTP cables according to TIA-568-C.2.

D. Factory test optical fiber cables according to TIA-526.14-B and TIA-568-C.3.

E. Factory sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results. Structural Return Loss shall be less than 20 db.

F. Cable will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for installation of supports for cables.

3.2 WIRING METHOD

A. Install wiring in metal pathways and wireways.
1. Minimum conduit size shall be 1 inch. Control and data-transmission wiring shall not share conduits with other building wiring systems.

2. Comply with requirements in Section 280528 "Pathways for Electronic Safety and Security."
3. Comply with requirements in Section 270536 "Cable Trays for Communications Systems."

B. Install cable, concealed in accessible ceilings, walls, and floors when possible.

C. Wiring on Racks and within Enclosures:
1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM's "Cabling Termination Practices" chapter. Cable ties shall not be excessively tightened such that the transmission characteristics of the cable are altered.
2. Install lacing bars and distribution spools.
3. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer.
4. Install conductors parallel with or at right angles to sides and back of enclosure.
5. Connect conductors associated with intrusion system that are terminated, spliced, or interrupted in any enclosure onto terminal blocks.
6. Mark each terminal according to system's wiring diagrams.
7. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1 and NFPA 70.

B. Conductors: Size according to system manufacturer's written instructions unless otherwise indicated.

C. Do not install conductors and cables that are wet, moisture damaged, or mold damaged.

D. Install UTP, optical-fiber, and coaxial cables and connecting materials after spaces are complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

E. General Requirements for Cabling:
1. Comply with TIA-568-C.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
5. Maintain minimum cable bending radius during installation and termination of cables.
6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions. Do not exceed manufacturer's rated cable-pulling tension.
9. Riser Cable: Riser cable support intervals shall be in accordance with manufacturer's recommendations.

10. Comply with Section 280544 "Sleeves and Sleeve Seals for Electronic Safety and Security Pathways and Cabling."

F. UTP Cable Installation: Install using techniques, practices, and methods that are consistent with Category 6A rating of components and that ensure Category 6A performance of completed and linked signal paths, end to end.
1. Comply with TIA-568-C.2.
2. Install 110-style IDC termination hardware unless otherwise indicated.
3. Do not untwist UTP cables more than 1/2 inch from point of termination to maintain cable geometry.

G. Optical-Fiber Cable Installation:
1. Comply with TIA-568-C.3.
2. Cable shall be terminated on connecting hardware that is rack or cabinet mounted.

H. Coaxial-Cable Installation:
1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.
2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches.
3. Install indoor cables in pathway.

I. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunication spaces with terminating hardware and interconnection equipment.
2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart. Cable supports shall be fastened to structural members or floor slabs in accordance with Section 260529 "Hangers and Supports for Electrical Systems."
3. Cable shall not be run in contact with pipes, ducts, or other potentially damaging items. Cables shall not be run through structural members or use structural members, pipes, ducts, or equipment as a support.

J. Installation of Cable Routed Exposed under Raised Floors:
1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Cable 72 inches long shall be neatly coiled not less than 12 inches in diameter below each feed point.

K. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA-569-C recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communication cables or cables in nonmetallic pathways and unshielded power conductors and electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).
3. Separation between communication cables in grounded metallic pathways and unshielded power lines or electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between cables in grounded metallic pathways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (75 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or hp and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.4 FIRE ALARM WIRING INSTALLATION

A. Comply with NECA 1 and NFPA 72.

B. Wiring Method: Install wiring in metal pathway according to Section 280528 "Pathways for Electronic Safety and Security."
   1. Install plenum cable in environmental air spaces, including plenum ceilings.
   2. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated pathway system. This system shall not be used for any other wire or cable.

C. Wiring Method:
   1. Cables and pathways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
   2. Fire-Rated Cables: Use of two-hour, fire-rated fire alarm cables, NFPA 70, Types MI and CI, is permitted.
   3. Signaling Line Circuits: Power-limited fire alarm cables shall not be installed in the same cable or pathway as signaling line circuits.

D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

F. Color Coding: Color code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm circuit wiring and another for supervisory circuits. Color code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

G. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.

H. Wiring to Remote Alarm Transmitting Device: 1-inch conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.5 POWER AND CONTROL-CIRCUIT CONDUCTORS

A. 120-V Power Wiring: Install according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables" unless otherwise indicated.

B. Minimum Conductor Sizes:
   1. Class 1 remote-control and signal circuits, No. 14 AWG.
   2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
   3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

3.6 CONNECTIONS

A. Comply with requirements in Section 281300 "Access Control" for connecting, terminating, and identifying wires and cables.

B. Comply with requirements in Section 282300 "Video Surveillance" for connecting, terminating, and identifying wires and cables.

C. Comply with requirements in Section 283111 "Digital, Addressable Fire-Alarm System" for connecting, terminating, and identifying wires and cables.

3.7 FIRESTOPPING

A. Comply with requirements in Section 078400 "Firestopping."

B. Comply with TIA-569-C, "Firestopping" Annex A.

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.8 GROUNDING

A. For communication wiring, comply with J-STD-607-A and with BICSI TDMM's "Grounding, Bonding, and Electrical Protection" chapter.

B. For low-voltage wiring and cabling, comply with requirements in Section 280526 "Grounding and Bonding for Electronic Safety and Security."

3.9 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections:

1. Visually inspect UTP and optical-fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations to confirm color coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross connection.
    a. Test instruments shall comply with or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
4. Optical-Fiber Cable Tests:
    a. Test instruments shall comply with or exceed applicable requirements in TIA-568-C.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    b. Link End-to-End Attenuation Tests:
        1) Attenuation test results for links shall be less than 2.0 db. Attenuation test results shall be less than that calculated according to equation in TIA-568-C.1.
5. Coaxial-Cable Tests:
    a. Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements.
    b. Replace malfunctioning or damaged items.
    c. Retest until satisfactory performance and conditions are achieved.
    d. Use an agile receiver and signal strength meter or spectrum analyzer for testing.
    e. Test Schedule: Schedule tests after pretesting has successfully been completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.
    f. Operational Tests: Perform tests of operational system to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.
    g. Distribution System Acceptance Tests:
        1) Field-Strength Instrument: Rated for minus 40-db mV measuring sensitivity and a frequency range of 54 to 812 MHz, minimum. Provide documentation of recent calibration against recognized standards.
        2) Signal Level and Picture Quality: Use a field-strength meter or spectrum analyzer, as well as a standard television receiver, to measure signal levels and check picture quality at 25 percent of user-interface outlets.
            a) Test the signal strength in db mV at 55 and 750 MHz.
            b) Minimum acceptable signal level is zero db mV (1000 mV).
            c) Maximum acceptable signal level over the entire bandwidth is 12 db mV.
            d) Television receiver shall show no evidence of cross-channel intermodulation, ghost images, or beat interference.
    h. Signal-to-Noise-Ratio Test: Use a field-strength meter to make a sequence of measurements at the output of the last distribution amplifier or of another agreed-on location in system. With system operating at normal levels, tune meter to the picture carrier frequency of each of the designated channels in turn, and record the level. With signal removed and input to corresponding headend amplifier terminated at 75 ohms, measure the level of noise at same tuning settings. With meter correction factor added to last readings, differences from first set shall not be less than 45 db.

i. Qualitative and Quantitative Performance Tests: Demonstrate reception quality of color-television program transmissions at each user interface from each designated channel and source. Quality shall be equal or superior to that obtained with performance checks specified below, using a standard, commercial, cable-ready, color-television receiver. Level and quality of signal at each outlet and from each service and source shall comply with the following Specifications when tested according to 47 604-12 76:
   1) RF video-carrier level.
   2) Relative video-carrier level.
   3) Carrier-level stability, during 60-minute and 24-hour periods.
   4) Broadband frequency response.
   5) Channel frequency response.
   6) Carrier-to-noise ratio.
   7) RF visual signal-to-noise ratio.
   8) Antenna combiner insertion loss.
   9) Signal power splitter loss.
   10) Cable connector attenuation.
   11) Cross modulation.
   12) Carrier-to-echo ratio.
   13) Composite triple beat.
   14) Second order beat.
   15) Terminal isolation.
   16) Terminal isolation between television and FM.
   17) Hum modulation.
   18) RF FM carrier level.
   19) FM frequency response.
   20) FM carrier-to-noise ratio.

D. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION

SECTION 28 05 13
CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

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7. Control-circuit conductors.
8. Fire alarm wire and cable.
9. Identification products.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. IDC: Insulation displacement connector.

C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

D. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

E. RCDD: Registered Communications Distribution Designer.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate layout and installation of electronic safety and security cabling with Owner's telecommunications and LAN equipment and service suppliers.

B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Installation data for UTP and optical-fiber cables as specified in TIA 569-C-1.
   2. For coaxial cable, include the following installation data for each type used:
      a. Nominal OD.
      b. Minimum bending radius.
      c. Maximum pulling tension.

B. Shop Drawings:
   1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
   2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
   3. Cabling administration drawings and printouts.
   4. Wiring diagrams to show typical wiring schematics, including the following:
      a. Cross-connects.
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   5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

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A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: An NRTL.
   1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

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A. Test cables upon receipt at Project site.
   1. Test optical-fiber cable to determine the continuity of the strand, end to end. Use optical loss test set.
   2. Test optical-fiber cable on reels. Use an optical time domain reflectometer to verify the cable length, and locate cable defects, splices, and connector; include the loss value of each. Retain test data and include the record in maintenance data.
   3. Test each pair of UTP cable for open and short circuits.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

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.

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels in Section 061000 "Rough Carpentry."

2.3 UTP CABLE

A. Manufacturer: Siemon

B. Description: 100-ohm, four-pair UTP, covered with a blue thermoplastic jacket.
1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA-568-C.1 for performance specifications.
3. Comply with TIA-568-C.2, Category 6A F\UTP.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
   a. Communications, Plenum Rated: Type CMP complying with NFPA 262.
   b.

2.4 UTP CABLE HARDWARE

A. Manufacturer: Siemon

B. UTP Cable Connecting Hardware: IDC type, using modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of the same category or higher.

C. Connecting Panels: 110-style for Category 6A F\UTP. Provide panel connectors for the number of cables terminated on the panel, plus 20 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

2.5 OPTICAL-FIBER CABLE

A. Manufacturer: Siemon

B. Description: Singlemode, 8.3/125 – 9/125 micrometer fiber, strands as noted, tight buffer, optical-fiber cable with interlocked armor jacket.
1. Comply with ICEA S-83-596 for mechanical properties.
2. Comply with TIA-568-C.3 for performance specifications.

3. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
   a. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
4.

C. Jacket:
1. Jacket Color: Yellow.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-C.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals.

2.6 OPTICAL-FIBER CABLE HARDWARE

A. Manufacturer: Siemon

B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

C. Patch Cords: Factory-made, dual-fiber cables in 36-inch lengths.

D. Cable Connecting Hardware: Comply with the Fiber Optic Connector Intermateability Standard (FOCIS) specifications of TIA-604-2-B, TIA-604-3-B, and TIA-604-12. Comply with TIA-568-C.3.
1. Quick-connect, simplex and duplex, Type LC connectors. Insertion loss not more than 0.75 db.

2.7 COAXIAL CABLE

A. Manufacturers: CommScope, Belden, Coleman, West Penn CDT

B. General Coaxial-Cable Requirements: Broadband type, recommended by cable manufacturer specifically for broadband data-transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 db maximum from 7 to 806 MHz.

C. RG-11/U (Plenum Rated): NFPA 70, Type CMP.
1. No. 14 AWG, solid, copper-covered steel conductor.
2. Gas-injected, foam-PE insulation.
3. Double shielded with 100 percent aluminum polyester tape and 60 percent aluminum braid.
4.
5. Suitable for outdoor installations in ambient temperatures ranging from minus 40 to plus 85 deg C.

D. RG-6/U (Plenum Rated): NFPA 70, Type CMP.
1. No. 18 AWG, solid, copper-covered steel conductor; foam fluorinated ethylene propylene insulation.
2. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.
3. Jacketed with PE.

E. NFPA and UL Compliance: Coaxial cables shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655 and with NFPA 70, Article 820

"Radio and Television Equipment" and Article 830 "Community Antenna Television and Radio Distribution Systems." Types are as follows:

1. CATV Plenum Rated: Type CATVP, complying with NFPA 262.

2.8 COAXIAL-CABLE HARDWARE

A. Coaxial-Cable Connectors:
   1. Type BNC, 75 ohms, crimp on style.
   2. Type F compression style for RG-6/U and RG-11/U cables.

2.9 RS-232 CABLE

A. RS-232 communications require three to nine conductors with an overall shield. Circuit is limited to a distance of not more than 50 feet (15 m). Add other conductor count cables as needed for the project.

B. Plenum-Rated Cable: NFPA 70, Type CMP.
   1. No. 22 AWG, stranded (7x30) tinned copper conductors.
   2. PE insulation.
   3. Aluminum foil-polyester tape shield with 100 percent shield coverage.
   4. Fluorinated ethylene propylene jacket.
   5. Conductors are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
   6. Flame Resistance: Comply with NFPA 262.

2.10 RS-485 CABLE

A. Plenum-Rated Cable: NFPA 70, Type CMP.
   1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
   2. Fluorinated ethylene propylene insulation.
   3. Unshielded.
   4. Fluorinated ethylene propylene jacket.
   5. Flame Resistance: NFPA 262, Flame Test.

2.11 CONTROL-VOLTAGE CABLE

A. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
   1. One pair, twisted, No. 16 AWG, stranded (19x29) and No. 18 AWG, stranded (19x30)] tinned copper conductors.
   2. PVC insulation.
   3. Unshielded.
   4. PVC jacket.
   5. Flame Resistance: Comply with NFPA 262.

2.12 CONTROL-CIRCUIT CONDUCTORS

A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, complying with UL 83, in pathway.

B. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, complying with UL 83, in pathway.

C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or TF in pathway.

2.13 FIRE ALARM WIRE AND CABLE

A. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

2.14 CONSOLIDATION POINTS

A. Description: Consolidation points shall comply with requirements for cable connecting hardware.
1. Number of Terminals per Field: One for each conductor in assigned cables.
2. Number of Connectors per Field:
3.
   a. One for each four-pair conductor group of indicated cables, plus 20 percent spare positions.
   b.
4. NRTL listed as complying with UL 50 and UL 1863.
5. When installed in plenums used for environmental air, NRTL listed as complying with UL 2043.

2.15 IDENTIFICATION PRODUCTS

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.16 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test UTP and optical-fiber cables on reels according to TIA-568-C.1.

C. Factory test UTP cables according to TIA-568-C.2.

D. Factory test optical fiber cables according to TIA-526.14-B and TIA-568-C.3.

E. Factory sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results. Structural Return Loss shall be less than 20 db.

F. Cable will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for installation of supports for cables.

3.2 WIRING METHOD

A. Install wiring in metal pathways and wireways.
1. Minimum conduit size shall be 1 inch. Control and data-transmission wiring shall not share conduits with other building wiring systems.
2. Comply with requirements in Section 280528 "Pathways for Electronic Safety and Security."
3. Comply with requirements in Section 260536 "Cable Trays for Electrical Systems."
4. Comply with requirements in Section 270536 "Cable Trays for Communications Systems."

B. Install cable, concealed in accessible ceilings, walls, and floors when possible.

C. Wiring on Racks and within Enclosures:
1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM's "Cabling Termination Practices" chapter. Cable ties shall not be excessively tightened such that the transmission characteristics of the cable are altered.
2. Install lacing bars and distribution spools.
3. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer.
4. Install conductors parallel with or at right angles to sides and back of enclosure.
5. Connect conductors associated with intrusion system that are terminated, spliced, or interrupted in any enclosure onto terminal blocks.
6. Mark each terminal according to system's wiring diagrams.
7. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1 and NFPA 70.

B. Conductors: Size according to system manufacturer's written instructions unless otherwise indicated.

C. Do not install conductors and cables that are wet, moisture damaged, or mold damaged.

D. Install UTP, optical-fiber, and coaxial cables and connecting materials after spaces are complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

E. General Requirements for Cabling:
1. Comply with TIA-568-C.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."

3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
5. Maintain minimum cable bending radius during installation and termination of cables.
6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions. Do not exceed manufacturer's rated cable-pulling tension.
9. Riser Cable: Riser cable support intervals shall be in accordance with manufacturer's recommendations.
10. Comply with Section 280544 "Sleeves and Sleeve Seals for Electronic Safety and Security Pathways and Cabling."

F. UTP Cable Installation: Install using techniques, practices, and methods that are consistent with **Category 6A** rating of components and that ensure **Category 6A** performance of completed and linked signal paths, end to end.
1. Comply with TIA-568-C.2.
2. Install 110-style IDC termination hardware unless otherwise indicated.
3. Do not untwist UTP cables more than 1/2 inch from point of termination to maintain cable geometry.

G. Optical-Fiber Cable Installation:
1. Comply with TIA-568-C.3.
2. Cable shall be terminated on connecting hardware that is rack or cabinet mounted.

H. Coaxial-Cable Installation:
1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.
2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches.
3. Install indoor cables in pathway.

I. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunication spaces with terminating hardware and interconnection equipment.
2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart. Cable supports shall be fastened to structural members or floor slabs in accordance with Section 260529 "Hangers and Supports for Electrical Systems."
3. Cable shall not be run in contact with pipes, ducts, or other potentially damaging items. Cables shall not be run through structural members or use structural members, pipes, ducts, or equipment as a support.

J. Installation of Cable Routed Exposed under Raised Floors:
1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Cable 72 inches long shall be neatly coiled not less than 12 inches in diameter below each feed point.

K. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-C recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communication cables or cables in nonmetallic pathways and unshielded power conductors and electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).
3. Separation between communication cables in grounded metallic pathways and unshielded power lines or electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
4. Separation between cables in grounded metallic pathways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (75 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or hp and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.4 FIRE ALARM WIRING INSTALLATION

A. Comply with NECA 1 and NFPA 72.

B. Wiring Method: Install wiring in metal pathway according to Section 280528 "Pathways for Electronic Safety and Security."
   1. Install plenum cable in environmental air spaces, including plenum ceilings.
   2. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated pathway system. This system shall not be used for any other wire or cable.

C. Wiring Method:
   1. Cables and pathways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
   2. Fire-Rated Cables: Use of two-hour, fire-rated fire alarm cables, NFPA 70, Types MI and CI, is permitted.
   3. Signaling Line Circuits: Power-limited fire alarm cables shall not be installed in the same cable or pathway as signaling line circuits.

D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring

diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

F. Color Coding: Color code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm circuit wiring and another for supervisory circuits. Color code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

G. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.

H. Wiring to Remote Alarm Transmitting Device: 1-inch conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.5 POWER AND CONTROL-CIRCUIT CONDUCTORS

A. 120-V Power Wiring: Install according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables" unless otherwise indicated.

B. Minimum Conductor Sizes:
1. Class 1 remote-control and signal circuits, No. 14 AWG.
2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

3.6 CONNECTIONS

A. Comply with requirements in Section 281600 "Intrusion Detection" for connecting, terminating, and identifying wires and cables.

B. Comply with requirements in Section 281300 "Access Control" for connecting, terminating, and identifying wires and cables.

C. Comply with requirements in Section 282300 "Video Surveillance" for connecting, terminating, and identifying wires and cables.

D. Comply with requirements in Section 283111 "Digital, Addressable Fire-Alarm System" for connecting, terminating, and identifying wires and cables.

3.7 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-C, "Firestopping" Annex A.

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.8 GROUNDING

A. For communication wiring, comply with J-STD-607-A and with BICSI TDMM's "Grounding, Bonding, and Electrical Protection" chapter.

B. For low-voltage wiring and cabling, comply with requirements in Section 280526 "Grounding and Bonding for Electronic Safety and Security."

3.9 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections:
1. Visually inspect UTP and optical-fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations to confirm color coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross connection.
    a. Test instruments shall comply with or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
4. Optical-Fiber Cable Tests:
    a. Test instruments shall comply with or exceed applicable requirements in TIA-568-C.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    b. Link End-to-End Attenuation Tests:
        1) Attenuation test results for links shall be less than 2.0 db. Attenuation test results shall be less than that calculated according to equation in TIA-568-C.1.
5. Coaxial-Cable Tests:
    a. Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements.
    b. Replace malfunctioning or damaged items.
    c. Retest until satisfactory performance and conditions are achieved.
    d. Use an agile receiver and signal strength meter or spectrum analyzer for testing.
    e. Test Schedule: Schedule tests after pretesting has successfully been completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.

f. Operational Tests: Perform tests of operational system to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.

g. Distribution System Acceptance Tests:
   1) Field-Strength Instrument: Rated for minus 40-db mV measuring sensitivity and a frequency range of 54 to 812 MHz, minimum. Provide documentation of recent calibration against recognized standards.
   2) Signal Level and Picture Quality: Use a field-strength meter or spectrum analyzer, as well as a standard television receiver, to measure signal levels and check picture quality at 25 percent of user-interface outlets.
      a) Test the signal strength in db mV at 55 and 750 MHz.
      b) Minimum acceptable signal level is zero db mV (1000 mV).
      c) Maximum acceptable signal level over the entire bandwidth is 12 db mV.
      d) Television receiver shall show no evidence of cross-channel intermodulation, ghost images, or beat interference.

h. Signal-to-Noise-Ratio Test: Use a field-strength meter to make a sequence of measurements at the output of the last distribution amplifier or of another agreed-on location in system. With system operating at normal levels, tune meter to the picture carrier frequency of each of the designated channels in turn, and record the level. With signal removed and input to corresponding headend amplifier terminated at 75 ohms, measure the level of noise at same tuning settings. With meter correction factor added to last readings, differences from first set shall not be less than 45 db.

i. Qualitative and Quantitative Performance Tests: Demonstrate reception quality of color-television program transmissions at each user interface from each designated channel and source. Quality shall be equal or superior to that obtained with performance checks specified below, using a standard, commercial, cable-ready, color-television receiver. Level and quality of signal at each outlet and from each service and source shall comply with the following Specifications when tested according to 47 604-12 76:
   1) RF video-carrier level.
   2) Relative video-carrier level.
   3) Carrier-level stability, during 60-minute and 24-hour periods.
   4) Broadband frequency response.
   5) Channel frequency response.
   6) Carrier-to-noise ratio.
   7) RF visual signal-to-noise ratio.
   8) Antenna combiner insertion loss.
   9) Signal power splitter loss.
   10) Cable connector attenuation.
   11) Cross modulation.
   12) Carrier-to-echo ratio.
   13) Composite triple beat.
   14) Second order beat.
   15) Terminal isolation.
   16) Terminal isolation between television and FM.
   17) Hum modulation.
   18) RF FM carrier level.
   19) FM frequency response.
   20) FM carrier-to-noise ratio.

D. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION

SECTION 280544

SLEEVES AND SLEEVE SEALS FOR ELECTRONIC SAFETY AND SECURITY PATHWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Sleeves for pathway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:
1. Division 26 Section "Common Work Results for Electrical" and "Sleeves and Sleeve Seals for Electronic Safety and Security Pathways and Cabling" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.
2. Penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:
1. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit EQ 4: For sealants, documentation indicating that products 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."

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:
1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

D. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

E. Sleeves for Rectangular Openings:
   1. Material: Galvanized-steel sheet.
   2. Minimum Metal Thickness:
      a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
      b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Advance Products & Systems, Inc.
      b. CALPICO, Inc.
      c. Metraflex Company (The).
      d. Pipeline Seal and Insulator, Inc.
      e. Proco Products, Inc.
   2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   3. Pressure Plates: Carbon steel.
   4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
   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. Presealed Systems.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
   1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
   2. Sealant shall have VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Silicone Foams: Multicomponent, silicone-based, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
   1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
      a. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants.".
      b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
   2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
   3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pathway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
   4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
   5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
   1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
   2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at pathway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 280544

SECTION 28 13 00269
ACCESS CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This section includes a complete installation of a PC based and managed access control and security system (Lenel) and specifies sensors, signal equipment, and system controls. The Lenel system shall be capable of functioning with both standard wired locks and card readers as well as with network connected integrated hardware.

B. The electrified locking and access hardware for this project is specified using ASSA ABLOY products that will require the security contractor to provide integrated access control connection locking devices and wire harnesses. Locking devices are specified to use either POE or standard wiring connections. Cabling for the POE locking devices shall be provided by Div 27 contractors with the security contractor providing the cabling for non POE locking hardware.

C. The system shall also interface with wireless access control for medical cabinets and refrigerators via wired hubs. Aperio IP hubs shall be provided for the wireless communication and wired connections back to the network patch panels. Provide optional external antenna with each hub.

1.3 DEFINITIONS

A. Hard-Wired System: Alarm, supervisory, and detection devices are directly connected, through individual dedicated conductors, to central control panels.

1.4 SYSTEM DESCRIPTION

A. The system shall have both access controlled doors and alarm inputs for panic buttons and intrusion detection.

B. The system shall support automatic responses to alarms entering the system. Each alarm condition shall be capable of initiating numerous events including but not limited to: Activation of remote devices, door control, remote annunciation LED’s, and card validation.

C. Access control functions shall include but not be limited to: Validation based on time of day and day of week, holiday scheduling with card validation override, and access validation based on positive verification of card.

D. The system shall interface with the fire alarm system and in the event of an alarm, shall release all controlled doors designated for emergency egress, and put them in fail-safe mode allowing free egress.

1.5 FUNCTIONAL PERFORMANCE

A. The system shall consist of a network controller and network nodes using a standard TCP/IP network. Each controller shall retain all data necessary for system operation in its own RAM. Each controller will contain an integrated real time clock that continues to govern events even if communication with the main network controller is interrupted.

B. The network controller shall act as an interface point with the node network, a data base management tool, and a transaction storage device.

1.6 ACTION SUBMITTALS

A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections

B. Product data for system components, including "Nationally Recognized Testing Laboratory" (NRTL) listing data and list of materials, dimensioned plans, sections, and elevations showing minimum clearances, mounting arrangements, and installed features and devices.

C. Wiring Diagrams and Door Elevations: Submit wiring diagrams and door elevations with product data in one submittal. Provide the following for each opening having electric hardware, except doors with only magnetic holder/release units.
   1. Wiring diagrams for scheduled items requiring power. Identify manufacturer-installed and field-installed wiring.
   2. Provide load calculations and requirements for each electro-mechanical locking device within +/-5% of 24 VDC. Size the conductors for each device appropriately to maintain this requirement.
   3. Provide cable type (as indicated on the Shop Drawings Wire Legend) that is used for each electro-mechanical locking device, the conductor size, the estimated total length of cable, the estimated line loss (voltage drop), and the percentage of estimated line loss (voltage drop).

D. System operation description, including method of operation and supervision of each component and each type of circuit, and sequence of operations for all manually and automatically initiated system inputs. Description must cover this specific Project; manufacturer's standard descriptions for generic systems are not acceptable.

1.7 CLOSEOUT SUBMITTALS

A. Operation and maintenance data for inclusion in "Operating and Maintenance Manual" specified in Division 01. Include data for each type product, including all features and operating sequences, both automatic and manual. Include user's software data and recommendations for spare parts to be stocked at the site. Provide names, addresses, and telephone numbers of service organizations that stock repair parts for the system.

B. Product certifications signed by the manufacturers of system components certifying that their products comply with the referenced standards.

C. Separate Qualification Data for Manufacturers and Installers: Demonstrate their capabilities and experience as specified in Quality Assurance Article. Include lists of completed projects with project names and addresses, names of Contracting Officer and Government representatives, plus other information specified.

D. Record of field tests of system.

1.8 QUALITY ASSURANCE

A. Convergint and Security 101 are Intermountain Healthcare's approved installers.

B. Comply with NFPA 70, "National Electrical Code."

C. Listing and Labeling: Provide system and components that are listed and labeled for their indicated use and location on the Project.
1. The Terms "Listed" and "Labeled": As defined in the "National Electrical Code," Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

D. Comply with UL Standard 609, 1023, and 1076.

E. FM Compliance: Provide FM approved card access system and components.

F. Single Source Responsibility: Obtain system components from a single source (the prime system manufacturer) that assumes responsibility for system components and for their compatibility.

G. The successful bidding contractor shall be required to have training and accreditation with both ASSA ABLOY and Lenel.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of card readers, sensors, equipment related to access control operation, etc., that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year from date of Substantial Completion.

1.10 COORDINATION

A. Access Control System Electrical Coordination: Coordinate with the layout and installation of scheduled electrified door hardware, and related access control equipment, with required connections to source power junction boxes, power supplies, detection and monitoring hardware and fire alarm system.
1. Door Hardware Interface: The card access control system shall be connected to electronic door control hardware (electromechanical locks, electric strikes, magnetic locks, door position switches, other monitoring contacts, and related auxiliary control devices) as described under Division 8 "Door Hardware". Coordinate with the installation and configuration of specified door hardware being monitored or controlled with the controls, software and access control hardware specified in this Section.

2. Access Control Hardware Sets: The hardware sets listed represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality. **Refer to Section 08 71 00 Door Hardware Schedule for hardware set information.**
3. Fire Alarm Interface: Review Door Hardware Schedule for sequence of operation requiring an interface with the fire alarm system, such as release upon fire alarm. Coordinate with the fire alarm installer to provide all fire alarm system components to accomplish the specified sequence of operation. Provide fire alarm release at all delayed egress doors and any other doors in the path of egress that are allowed to be locked.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 ACCESS CONTROL SYSTEM EQUIPMENT, GENERAL

A. Surge Protection: Comply with minimum requirements of UL Standard 1449, "Transient Voltage Surge Suppressors," for each component using solid state devices and having a line voltage power source connection or an exterior underground signal connection.

B. Provide at the locations identified, a complete and operational Access Control and Security System including but not limited to the following equipment:
   1. Card Readers
   2. Door Logic Panels
   3. Relay output contacts
   4. All power supplies and/or transformers
   5. All equipment, security devices, components, wire, cable, and mounting hardware as required to meet specification requirements and manufacturers documented installation procedures.

C. Provide the quantity of new door licenses to the existing Lenel building package to accommodate the increased number of readers being added as part of this project.

2.3 PHYSICAL SECURITY APPLIANCE

A. Physical Security Appliance (PSA): Stand-alone, modular multi-reader access controller shall be provided for standard door opening access control. The appliances shall communicate to the main system server using Ethernet TCP/IP, and shall serve as the data collection and communications interface between the system server and the various field devices such as card readers, alarm inputs and control outputs.

B. Power Requirements: Each Physical Security Appliance (PSA) shall accept a power input voltage of 120 VAC, 60Hz. Maximum power draw shall be no more than 300W. The PSA shall generate appropriate DC voltage levels for on-board use as required. External lock power supplies shall be required and sized for the appropriate number of locks (plus 20%) associated with each distributed controller. All power outputs to external devices shall be current limited in accordance with class 2 power limited wiring standards

C. Battery Backup: The power supplies inherent in the PSA shall have the capability of charging standard gel-cell batteries, and shall be capable of operating on direct battery backup. The PSA shall be capable of providing at least four hours of full operation backup time, and shall be capable of recharging its batteries in less than 48 hours. Batteries shall be mounted in a separate, dedicated battery shelf sized to contain the amount of batteries required.

2.4 ELECTRICAL POWER

A. Normal System Power Supply: 120 V 60 Hz from locked disconnect device. System components are supplied with power through separate power supplies. Provide all required power supplies and associated transformers as specified by the manufacturer.

B. Power Source Transfer: When normal power is interrupted, system is automatically switched to backup supply without degradation of critical system function or loss of signals or status data.
1. Backup Source: Batteries in power supplies of individual system components. Such batteries are an integral part of power supplies of the components.
2. Annunciation: Switching of the system or any system component to backup power is indicated as a change in system condition.

2.5 CARD ACCESS SYSTEM HARDWARE, GENERAL

A. Types, features, accessories, and mounting conditions of individual devices are as indicated.

B. Battery Backup: The access control panel shall be provided with back up battery power for up to four hours operation upon loss of AC power.

C. Suppression: The access control panel shall have provisions for relay suppressor kits for each relay used, to protect the access control panel from collapsing electrical fields.

D. Card Readers:
1. Behavioral Health Spaces: Card readers shall be Essex iRox Pro+ multiclass SE readers.
   a. Proximity Readers: The system shall be provided with uni directional proximity card readers. The standard multi-class SE readers shall have a read range of five to eight inches. The reader shall be able to be mounted with its sides against metal door or window frames, and masonry walls. Provide tamper resistant TORX screws.
   b. Standard readers: IRXPO-2-S-LRB
2. Non-Behavioral Health Spaces: Card readers shall be HID multi-class SE readers.
   a. Proximity Readers: The system shall be provided with uni directional proximity card readers. The standard multi-class SE readers shall have a read range of five to eight inches. The reader shall be able to be mounted with its sides against metal door or window frames, and masonry walls. Long range readers mounted at vehicle gates shall have a minimum 10 inch read range.
   b. Standard readers: HID RP40
   c. Keypad/Pinpad: HID RPK40
   d. Mullion Installation: HID RP10

2.6 POWER SUPPLIES

A. Provide power supplies as per manufacturers written recommendations with total number of powered devices for each power supply restricted to only consuming 75 percent of the power supplies rated amperage. Provide separate power supplies for system controllers (As per manufacturer), card readers (12VDC, 5 A), and locks (24 VDC, 7 A).

2.7 CONTACT INDICATOR SWITCHES

A. Contact indicators on overhead doors that are not supplied by the door manufacturer shall be Sentrol series 2300 type surface mounted magnetic reed type switches with opposing magnet, and shall be per manufacturer's recommendations for the type of door.

2.8 WIRE AND CABLE

A. Cables: Bundled, shielded and unshielded, twisted-pair cable, shielded where manufacturer recommends shielded cable for standard readers and locking hardware. Cat 6A cable shall be provided by Div 27 to all network connected locking hardware.
   1. Specified Manufacturer: Provide the specified product or prior approved equal.
      a. Coleman Cable Inc. (CCI) Part Number 73101 consisting the following cables bundled plenum rated within a yellow Low Smoke PVC, CMP/CL3P/FPLP jacket:
         1) PN 72321: 22 AWG 2/Conductor CMP. Typical use, Door Contact
         2) PN 72344: 22 AWG 4/Conductor CMP. Typical use, Request to Exit/Spare
         3) PN 75366: 22 AWG 6/Conductor shielded CMP. Typical use, Card Reader.
         4) PN 71944: 18 AWG 4/Conductor CMP. Typical use, Lock Power
      b. Any of the above cables may be used individually where cables in addition to those included in the bundle are required.

B. Comply with Division 26 Section "Wires and Cables" except as indicated.

C. Cable for Low Voltage Control and Signal Circuits: Shielded twisted pair cable with drain. Comply with Division 26 Section "Wires and Cables."

2.9 RACEWAY

A. Comply with Division 26 Section "Raceways."

2.10 DOOR HARDWARE SCHEDULE

A. Refer to Section 08 71 00 Door Hardware Schedule for hardware set information and assignment of required components to be provided by the Division 28 contractor.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.

B. Examine roughing-in for card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Comply with recommendations in SIA CP-01.

B. Comply with TIA/EIA 606-A, "Administration Standard for Commercial Telecommunications Infrastructure."

C. Obtain detailed Project planning forms from manufacturer of access-control system; develop custom forms to suit Project. Fill in all data available from Project plans and specifications and publish as Project planning documents for review and approval.
1. For each Location, record setup of controller features and access requirements.
2. Prepare a specific plan for system testing, startup, and demonstration.
3. Develop acceptance test concept and, on approval, develop specifics of the test.
4. Develop cable and asset-management system details; input data from construction documents.

3.3 INSTALLATION

A. General: Install system according to NFPA 70, applicable codes, and manufacturer's printed instructions.

B. Intermountain Healthcare Approved Installers:
1. Convergint
2. Security 101

C. Wiring Method:
1. Concealed in walls or above inaccessible ceilings: Install all cabling in raceways, 1inch minimum. Conduit fill shall not exceed 40%.
2. Above Accessible Ceilings: Provide J-Hooks at not more than 5 feet on center. Fasten J-Hooks to walls with solid anchoring to studs. Where wall are unavailable suspend from structure using not less than 3/8” diameter threaded rod and provide tie to ceiling grid to prevent sway.
3. Exposed: Install exposed cables in minimum 3/4” galvanized rigid metal conduit with straps at not more than 3 feet on center and minimum 1/4” gap between conduit and building surface. Use boxes that are specified for surface mounting.

D. Wiring within Panels and Enclosures: Bundle, wrap, and train the conductors to terminal points with 6-inches of slack minimum, 12-inches of slack maximum. Provide and use cable management hardware and distribution spools.

E. Number of Conductors: As recommended by system manufacturer for functions indicated. As a minimum install one bundled, shielded and unshielded, twisted pair cable for every access controlled door.

F. Splices, Taps, and Terminations: Make splices, taps, and terminations on numbered terminal strips in junction, pull and outlet boxes, terminal cabinets, and equipment enclosures.

G. Tighten connections to comply with tightening torques specified in UL Standard 486A.

H. Identification of Conductors and Cables: Color code conductors and apply wire and cable marking tape to designate wires and cables so media are identified and coordinated with system wiring diagrams.

I. Install power supplies and other auxiliary components for detection devices at the door controller panel or at a data gathering panel except as otherwise indicated. Do not install such items in the vicinity of the devices they serve.

3.4 GROUNDING

A. Comply with Section 280526 "Grounding and Bonding for Electronic Safety and Security."

B. Comply with IEEE 1100, "Recommended Practice for Power and Grounding Electronic Equipment."

C. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

D. Bond shields and drain conductors to ground at only one point in each circuit.

3.5 DOOR RELEASE BUTTON INSTALLATION

A. Push Buttons: Push-button switches shall be connected to the controller associated with the portal to which they are applied, and shall operate the appropriate electric strike, electric lock, or other facility release device. The system shall also use card readers in place of push-buttons at designated locations for remote operation of access controlled doors.

3.6 IDENTIFICATION

A. In addition to requirements in this article, comply with applicable requirements in Section 260553 "Identification for Electrical Systems" and with TIA/EIA 606-A.

B. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
   1. All wiring conductors connected to terminal strips shall be individually numbered, and each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with the name and number of the particular device as shown.
   2. Each wire connected to building-mounted devices is not required to be numbered at the device if the color of the wire is consistent with the associated wire connected and numbered within the panel or cabinet.

3.7 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Provide services of a factory authorized service representative to supervise the field assembly and connection of components and system pre-testing, testing, adjustment, and programming.

B. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.

C. Pre-testing: Align and adjust the system and perform pre-testing of all components, wiring, and functions to verify conformance with specified requirements. Correct deficiencies by replacing malfunctioning or damaged items with new items. Retest until satisfactory performance and conditions are achieved.

D. Testing: Provide at least 10 days' notice of acceptance test performance schedule.

E. Operational Tests: Perform operational system tests to verify conformance with specifications. Test all modes of system operation and intrusion detection. Methodically test for false alarms in each zone of space intrusion detection devices by simulating activities outside indicated detection patterns.

F. Installer Start-up Responsibility: The Installer shall initiate system operation. The Installer shall provide competent start up personnel on each consecutive working day until the system is fully functional. Upon reoccurring technical problems, the Installer shall supply factory direct Manufacturer's support in the form of factory technical representation and/or diagnostic equipment until the resolution of those defined problems.

3.8 ADJUSTMENT

A. Occupancy Adjustments: When requested within 1 year of date of substantial completion, provide on site assistance in adjusting and reprogramming to suit actual occupied conditions. Provide up to 3 visits to the site for this purpose without additional cost.

3.9 DEMONSTRATION

A. Train Owner's operating personnel in the programming and operation of the system. Train Owner's maintenance personnel in the procedures and schedules involved in preventive maintenance and in programming, operating, adjusting, troubleshooting, and servicing of the system. Provide a minimum of 4 hours training.

B. Schedule training with advance notice of at least 7 days.

END OF SECTION

SECTION 281500 - INTEGRATED ACCESS CONTROL HARDWARE DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes access control door hardware for the following:

1. Swinging doors.
2. Other doors to the extent indicated.

B. Section includes, but is not necessarily limited to, the following for the integrated access control security and site management system:

1. Electrified and Integrated Access Control Card Key Door Hardware

C. Related Sections include the following:

1. Division 01 Section “Cash Allowances”.
2. Division 01 Section “Product Allowances”.
3. Division 08 Section “Door Schedule”.
4. Division 08 Section “Door Hardware Schedule”.
5. Division 08 Section "Hollow Metal Doors and Frames."
6. Division 08 Section "Flush Wood Doors".
7. Division 08 Section "Clad Wood Doors".
8. Division 08 Section "Stile and Rail Wood Doors".
9. Division 08 Section “Fiberglass Doors”,
10. Division 08 Section "Integrated Door Opening Assemblies".
11. Division 08 Section "Aluminum-Framed Entrances and Storefronts".
12. Division 08 Section "All-Glass Entrances".
13. Division 08 Section "Automatic Entrances".
14. Division 08 Section "Door Hardware".
15. Division 08 Section "Automatic Door Operators".
16. Division 14 Section "Elevators" for security access to elevator floor selection controls.
17. Division 26 Section "Electrical" for connections to electrical power system and for low voltage wiring work.
18. Division 27 Section "Communications" for connections to the LAN.
19. Division 28 Section "Access Control" for access control devices and equipment installed at door openings and provided as part of a security and site management system.

20. Division 28 Section "Intrusion Detection" for detection devices installed at door openings and provided as part of an intrusion detection system.
21. Division 28 Section "Video Surveillance" for motion detection and video camera devices and equipment installed at door openings and provided as part of a security and site management system.
22. Division 28 Section "Fire Detection and Alarm" for connections to building fire alarm system.

D. References:

1. ANSI A117.1 (1998) - Accessible and Usable Buildings and Facilities.
2. IBC - International Building Code
3. NFPA 70 (2002) - National Electrical Code.
4. NFPA 80 (1999) - Fire Doors and Windows.
5. NFPA 101 (2006) - Life Safety Code.
6. UL 294 - Access Control Systems.
7. UL 1076 - Proprietary Burglar Alarm Units and Systems.

E. Products installed, but not provided under this Section include the following. Coordination to remain a requirement of this Section.

1. Security or High Security keyed cylinders, including provisions for temporary construction keying, for mechanical override at access control locking hardware to be furnished under Division 8 Section "Door Hardware".

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. System Operational Descriptions: Complete system operational narratives for the integrated access-controlled openings defining the owner's prescribed requirements for the opening functionality. Narratives include, but are not limited to, the following situations: normal secured/unsecured state of door; authorized access; authorized egress; unauthorized access; unauthorized egress; fire alarm and loss of power conditions, and interfaces with other building control systems.

C. Shop Drawings: Details of electrified integrated locking hardware and access control firmware, indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication and control of the access control system electrified hardware and firmware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

a. Elevation diagram of each unique access-controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
b. Complete (risers, point-to-point) access control system block wiring diagrams.

2. Electrical Coordination: Coordinate with related Electrical Sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Proof of Certification: Upon request provide a copy of manufacturer(s) official certification or accreditation document indicating proof of status as a qualified and authorized provider of the primary access control components.

E. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete access control and site management installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and telephone number of the supplier/integrator providing the installation and the nearest service representatives for each item of equipment included in the system. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.

1. As-Built Drawings: During system installation, the Contractor to maintain a separate hard copy set of drawings, elevation diagrams, and wiring diagrams of the access control system to be used for record drawings. This set to be kept up to date by the Contractor with all changes and additions to the access control system accurately recorded.

F. Warranties and Maintenance: Special warranties and maintenance agreements specified in this Section.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum of five (5) years of documented experience in providing access control and security systems equipment and software similar to that indicated for this Project and that have a proven record of successful in-service performance.

1. Software and access control systems components to have been previously and thoroughly tested together with proven installations similar in size and functionality to the design requirements indicated for this Project.

B. System Integrator Qualifications: Systems Integrators, verifiably factory trained and certified by the primary product manufacturers, with a minimum of three (3) years documented experience installing complete integrated access control systems similar in material, design, and scope to that indicated for this Project and whose work has resulted in construction with a proven record of successful in-service performance. Qualifications include, but are not necessarily limited, to the following:

1. References: Provide a list of references for similar projects including contact name, phone number, name and type of project.
2. Professional Staffing: Firms to have a dedicated access control systems integration department with full time, experienced professionals on staff experienced in providing on site consulting services for both electrified door hardware and integrated access control systems installations.
3. Factory Training: Installation and service technicians are to be competent factory trained and certified personnel capable of maintaining the system.

4. Service Center: Firms to have a service center capable of providing training, in-stock parts, and emergency maintenance and repairs at the Project site with 24-hour/7-days a week maximum response time.

C. Installer Qualifications: Certified technicians, verifiably authorized with the primary product manufacturers for installation of IP-Enabled, Wireless, and Power-over-Ethernet Access Control products in accordance with documented instructions and NFPA 80.

1. ASSA ABLOY access control products are required to be installed only through designated "Preferred Installers."

D. Source Limitations: Obtain the access control door hardware, system firmware and application software specified in this Section from a single source, qualified supplier/integrator unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
2. Provide integrated access control door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

E. Regulatory Requirements: Comply with NFPA 70, NFPA 80, NFPA 101 and ANSI A117.1 requirements and guidelines as directed in the model building code including, but not limited to, the following:

1. Comply with NFPA 70 "National Electrical Code", including electrical components, devices, and accessories listed and labeled as defined in Article 100 by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
2. Where indicated to comply with accessibility requirements, comply with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," ANSI A117.1.
3. Comply with NFPA 101 "Life Safety Code" for doors in a means of egress.
4. Comply with NFPA 80 "Fire Doors and Windows" for fire labeled opening assemblies.
5. The installed access control system shall conform to all local jurisdiction requirements.

F. Keying Conference: Reference Division 8 Section "Door Hardware".

G. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier/Dealer, Systems Integrator, and Contractor to review proper methods and procedures for receiving, handling, and installing the access control system hardware. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedules.

1. Inspect and discuss Division 26 electrical roughing-in and similar preparatory work performed by other trades.
2. Review and verify sequence of operation descriptions for each unique access controlled opening.
3. Review and finalize construction schedule and verify availability of materials.
4. Review the required inspecting, testing, commissioning, and demonstration procedures.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store electronic access control hardware, software or related accessories at Project site without prior authorization.

1. Access control firmware and software: Where approved and directed, inventory upon receipt and store electronic access control equipment in a secure, temperature and humidity controlled environment in original manufacturer's sealed containers.

B. Tag each item or package separately with identification related to the final Access Control Door Schedule, and include basic installation instructions with each item or package.

C. Deliver permanent keys, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner established at the “Pre-Submittal Conference".

1.6 COORDINATION

A. Coordinate quantity and arrangement of assemblies with ceiling space configuration and with components occupying ceiling space, including structural members, pipes, air-distribution components, raceways, cable trays, recessed lighting fixtures, and other items.

B. Access Control System Electrical Coordination: Coordinate the layout and installation of scheduled electrified door hardware, and related access control equipment, with required connections to source power junction boxes, power supplies, detection and monitoring hardware and fire alarm system.

1. Door Hardware Interface: The card key access control system to interface and be connected to electronic door control hardware (electromechanical locks, electric strikes, magnetic locks, door position switches, other monitoring contacts, and related auxiliary control devices) as described under Division 8 "Door Hardware". Coordinate the installation and configuration of specified door hardware being monitored or controlled with the controls, software and access control hardware specified in this Section.

C. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing electrified door hardware and access control system components. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing access control system hardware to comply with indicated requirements.

D. Door and Frame Preparation: Related Division 08 Sections (Steel, Aluminum and Wood) doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article will not deprive Owner of other rights Owner may have under other provisions of

the Contract Documents and are in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of the installed access control system hardware and software that fails in materials or workmanship, including all related parts and labor, within specified warranty period after final testing and acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods (Electrified Access Control Door Hardware):

1. Two years for Electrified, Wiegand Output, and IP-Enabled Access Control Door Hardware.

E. Maintenance Support and Extended Service Agreement: Submit for Owner’s consideration an optional extended Service Agreement for the installed access control system, including support for software related issues. The extended Service Agreement is considered elective and is without manufacturer's requirement stipulating mandatory coverage for owner and/or vendor system support.

1. A published copy of this agreement to be included with the submittal package
2. Support for the installed access control system components is provided through the vendor under a 24 hour technical assistance program.
3. Access control and management system components are to be available on a one-day turn around time frame from the manufacturer.
4. Primary systems manufacturer to offer and provide remote modem or internet access for direct factory support to the vendor. The factory level support to include diagnostics and troubleshooting support on systems related issues at no additional cost to the owner.

F. Access Control Software Upgrades: Version upgrades and "fix" releases to the access control system software are available at no extra charge as long as the version of software provided under this specification remains the current manufacturer’s version or for up to (2) years after a new version release.

1. Major access control software revisions that provide new functionality to the product provided free of charge for up to one (1) year from the date of substantial completion.
2. Access control system software is to be upgradable as may be required or as necessary, to expand and manage the owner’s site or sites. Upgrades are to be offered at a published flat fee for the primary system software, with single license modules included in the primary fee structure. System upgrades offered at a costing structure based upon the original number of licensed modules issued, or on those to be purchased at a future date, are not allowed.

3. As part of the submittal package, provide a list of available software upgrades and/or expansions modules. List to identify related costs for upgrades, or expansions to the original system, up to the next qualifying operational level.

1.8 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of the installed access control system hardware and components.

B. Maintenance Service: Beginning at Substantial Completion, and running concurrent with the specified warranty period, provide continuous (6) months full maintenance by skilled employees of the Systems Integrator. Include repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door opening operation. Provide parts and supplies as used in the manufacture and installation of original products.

PART 2 - PRODUCTS

A. Integrated Wired Output Multi-Class Cylindrical Locks: Wiegand or Open Supervised Device Protocol (OSDP)output ANSI A156.2, Grade 1, Cylindrical Lockset with integrated card reader with or without keypad option, and request-to-exit signaling in one complete unit. Hard wired, solenoid driven locking/unlocking control of the lever handle trim with 1/2" deadlocking stainless steel latch. Lock is U.L listed and labeled for use on up to 3 hour fire rated openings.

1. Open architecture, hard wired platform supports centralized control of locking units with new or existing Wiegand or OSDP compatible access control systems. Inside lever handle (request-to-exit) signaling standard with door position (open/closed status) monitoring (via separately connected DPS).
2. Integrated reader supports the following credentials:
   a. 125kHz proximity credentials: HID, AWID, Indala, and EM4102.
   b. 13.56 MHz proximity credentials: HID Secure Identity Object™ (SIO) on iCLASS Seos, HID iCLASS, HID iCLASS SE/SR, MIFARE Classic, DESFire EV1 and EV2.
   c. 2.4 GHz credentials: Secure Identity Object™ (SIO) on Mobile IDs (Bluetooth Smart)
   d. ISO14443A/B (PIV-compatible Transparent FASC-N read) available with pivCLASS variant
   e. NFC-enabled mobile phones
   f. PIN code only or PIN + credential with keypad option
3. 12VDC external power supply required for reader and lock, with optional 24VDC lock solenoid. Fail safe or fail secure options.
4. Installation requires only one cable run from the lock to the access control panel without requirements for additional proprietary lock panel interface boards or modules.
5. Installation to include manufacturer's access control panel interface board or module where required for Wiegand or OSDP output protocol.

6. Manufacturers:

   a. Corbin Russwin (RU) - CLX3300 SN Series.

b. Sargent Manufacturing (SA) - SN200/SN210 10X Line.

2.2 POWER SUPPLIES

A. Intelligent Switching Power Supplies: Provide the least number of power supplies at the appropriate amperage level sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.

1. Power supplies shall meet all functions and features as specified herein.

a. UL listed dual voltage 12 or 24 VDC field selectable continuous output.
b. Dedicated fast charger to prolong battery life with low battery cutoff to protect batteries from deep discharge.
c. Enhanced surge immunity for input/output protection
d. Separate, dedicated battery charging circuit to keep locks cooler.
e. Dual-color LED visual notification to prevent applying incorrect voltages to the power supply.
f. Instant auto-switch to battery on AC loss.
g. Expandable up to 16 outputs in the standard enclosure
h. Integrated fire alarm interface to allow main output shutdown or disconnect on a per output basis when using an R8 output module.
i. Network ready and remotely manage locks and connected devices when using an M8 managed output module on network models.
j. Lifetime replacement, no-fault, no questions asked warranty.

2. Manufacturers:

a. Securitron (SU) - AQL Series.

2.3 CABLES AND WIRING

A. Comply with Division 27 Section "Conductors and Cables for Electronic Safety and Security."

B. Data Line Supervision: System to include alarm initiation capability in response to opening, closing, shorting, or grounding of data transmission lines.

C. Install appropriate number of conductor pairs, in the wire gage (AWG) recommended by manufacturer, corresponding to the electronic locking functions specified, amperage drawn and distances covered between the power supplies, power transfer devices, electrified hardware and access control equipment.

2.4 ACCESS CONTROL HARDWARE FINISHES

A. Standard: Comply with BHMA A156.18.

B. Protect mechanical finishes on exposed surfaces from damage by applying temporary protective coverings before shipping.

C. Where specified, finishes on integrated card key locksets or exit hardware to incorporate an FDA recognized antimicrobial coating (i.e., MicroShield™) listed for use on equipment as a suppressant to the growth and spread of a broad range of bacteria, algae, fungus, mold and mildew.

D. BHMA Designations: Comply with base material and finish as specified.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance of the installed access control system.

B. Examine roughing-in for electrical source power to verify actual locations of wiring connections before electrified and integrated access control door hardware installation.

C. Examine roughing-in for LAN and control cable conduit systems to PCs, controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.

D. Notify architect of any discrepancies or conflicts between the specifications, drawings and scheduled access controlled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Doors and frames at scheduled access controlled openings to be properly prepared to receive specified electrified and access control hardware and connections without additional in-field modifications.

3.3 INSTALLATION

A. Install each item of electronic integrated door hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

B. Mounting Heights: Mount electronic integrated door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."

C. Boxed Power Supplies: Verify locations.

1. Configuration: Provide the least number of power supplies required to adequately serve doors with access control hardware and equipment.

D. Final connect the system control switches (integrated card key locking hardware, remote readers, keypads, display terminals, biometrics), and monitoring, and signaling equipment to the related Controller devices at each opening to properly operate the electrified door and access control hardware according to system operational narratives.

E. Retrofitting: Install each door hardware and access control item to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

F. System Application Software: Install, and test application(s) software and databases for the complete and proper operation of systems involved. Assign software license(s) to Owner.

3.4 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

B. Commissioning and Testing Schedule: Prior to final acceptance of the access control system installation, the following testing and documentation to be performed and provided to the Owner.

1. Inspection: Verify that units and controls are properly installed, connected, and labeled and that interconnecting wires and terminals are identified.
2. Pre-testing: Program and adjust the system and pretest all components, wiring, and functions to verify they conform to specified requirements. Provide testing reports indicating devices tested, pass/fail status, and actions taken to resolve problem(s) on failed tests.
3. Acceptance Test Schedule: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
4. Provide “as designed” drawings showing each device and wiring connection and electronic enclosure legends indicating cabling in and out.
5. Provide a complete set of operating instructions for access control hardware devices and a complete software user manual. The documentation includes module reference guides for each electronic enclosure.

3.5 ADJUSTING

A. Adjust and check each operating item of integrated access control door hardware, and each door opening to ensure proper secured operation and function of every unit. Replace units that cannot be adjusted to operate as intended.

3.6 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by access control system installation.

B. Clean operating items as necessary to restore proper finish and provide final protection and maintain conditions that ensure access control door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Engage an authorized systems manufacturer representative to train Owner's maintenance personnel to adjust, operate, and maintain electronic integrated door hardware and the access control system.

3.8 ACCESS CONTROL HARDWARE SETS

A. The access control system hardware sets listed below represent the design intent and direction of the owner, architect, and security consultant (as applicable). They are intended as a guideline only and should not be considered a detailed opening schedule. Discrepancies, conflicting, and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

B. The supplier is responsible for handing and sizing all products and providing the correct option for the appropriate door type and material where more than one is presented in the hardware sets. Quantities listed are for each pair of doors, or for each single door.

C. Refer to Section 087100 Door Hardware for hardware sets.

END OF SECTION 281500

SECTION 28 31 11

DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Nonsystem smoke detectors.
5. Heat detectors.
6. Notification appliances.
7. Firefighters' two-way telephone communication service.
8. Magnetic door holders.
9. Remote annunciator.
10. Addressable interface device.
11. Digital alarm communicator transmitter.
12. Radio alarm transmitter.
13. System printer.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. NICET: National Institute for Certification in Engineering Technologies.

1.4 SYSTEM DESCRIPTION

A. Noncoded, UL-certified FMG-placarded addressable system, with automatic sensitivity control of smoke detectors and multiplexed signal transmission, dedicated to fire-alarm service only.

1.5 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.6 ACTION SUBMITTALS

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

B. Shop Drawings: For fire-alarm system, submit shop drawings with product data in one submittal. Include plans, elevations, sections, details, and attachments to other work.
1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
2. Include voltage drop calculations for notification appliance circuits.
3. Include fire alarm zoning diagrams indicating zoning of the fire alarm system coordinated with the corresponding fire protection zones and smoke compartments. Comply with NFPA 99.
4. Include battery-size calculations.
5. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.

6. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations. Provide remote test switches (RTS) as required by NFPA 72.
7. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
8. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

C. General Submittal Requirements:
1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:
   a. Trained and certified by manufacturer in fire-alarm system design.
   b. NICET-certified fire-alarm technician, Level III minimum.
   c. Licensed or certified by authorities having jurisdiction.

D. Delegated-Design Submittal: For smoke and heat detectors 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. Drawings showing the location of each smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the detector.
2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.8 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
3. Record copy of site-specific software.
4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
   a. Frequency of testing of installed components.
   b. Frequency of inspection of installed components.
   c. Requirements and recommendations related to results of maintenance.
   d. Manufacturer's user training manuals.
5. Manufacturer's required maintenance related to system warranty requirements.

6. Abbreviated operating instructions for mounting at fire-alarm control unit.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.9 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. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
3. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than 1 unit of each type.
4. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no fewer than 1 unit of each type.
5. Keys and Tools: One extra set for access to locked and tamperproofed components.
6. Audible and Visual Notification Appliances: One of each type installed.
7. Fuses: Two of each type installed in the system.

1.10 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician.

C. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.

D. 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.

E. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL.

F. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

G. NFPA Certification: Obtain certification according to NFPA 72 in the form of a placard by an FMG-approved alarm company.

H. NFPA Certification: Obtain certification according to NFPA 72 by the Authority Having Jurisdiction.

1.11 PROJECT CONDITIONS

A. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:

1. Notify Construction Manager no fewer than 7 days in advance of proposed interruption of fire-alarm service.
2. Do not proceed with interruption of fire-alarm service without Construction Manager's written permission.

1.12 SEQUENCING AND SCHEDULING

A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.

B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

1.13 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning with Substantial Completion, provide software support for two years.

C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide product by the following:

1. Notifier
2. Siemens

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices[and systems]:

1. Manual stations.
2. Smoke detectors.
3. Duct smoke detectors.
4. Verified automatic alarm operation of smoke detectors.
5. Automatic sprinkler system water flow.
6. Heat detectors in elevator shaft and pit.
7. Fire-extinguishing system operation.
8. Fire standpipe system.

B. Fire-alarm signal shall initiate the following actions:

1. In the Clinic and Central Utility Plant (CUP), continuously operate alarm notification appliances.
2. In the hospital, continuously operate chime/strobe appliances in smoke zone where alarm is initiated. Continuously operate strobe appliances throughout the hospital
3. Identify alarm at fire-alarm control unit and remote annunciators.
4. Transmit an alarm signal to the remote alarm receiving station.
5. Unlock electric door locks in designated egress paths.
6. Release fire and smoke doors held open by magnetic door holders.
7. Activate voice/alarm communication system.
8. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
9. Activate smoke-control system (smoke management) at firefighter smoke-control system panel.
10. Activate stairwell and elevator-shaft pressurization systems.
11. Close smoke dampers in air ducts of designated air-conditioning duct systems.
12. Recall elevators to primary or alternate recall floors.
13. Activate emergency lighting control.
14. Activate emergency shutoffs for gas and fuel supplies.
15. Record events in the system memory.
16. Record events by the system printer.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. Low-air-pressure switch of a dry-pipe sprinkler system.

3. Elevator shunt-trip supervision.

D. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at fire-alarm control unit.
4. Ground or a single break in fire-alarm control unit internal circuits.
5. Abnormal ac voltage at fire-alarm control unit.
6. Break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at fire-alarm control unit or annunciator.
9. Fire-pump power failure, including a dead-phase or phase-reversal condition.
10. Low-air-pressure switch operation on a dry-pipe or preaction sprinkler system.

E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators. Record the event on system printer.

2.3 FIRE-ALARM CONTROL UNIT

A. General Requirements for Fire-Alarm Control Unit:
1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.
a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
b. Include a real-time clock for time annotation of events on the event recorder
c. Must be able to operate and monitor Pre-action systems throughout hospital

2. Addressable initiation devices that communicate device identity and status.
a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at fire-alarm control unit.
b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.

3. Addressable control circuits for operation of mechanical equipment.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
1. Annunciator and Display: Liquid-crystal type, 3 line(s) of 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

C. Circuits:
1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class A.
a. Initiating Device Circuits: Style D.
b. Notification Appliance Circuits: Style Z.
c. Signaling Line Circuits: Style 7.
d. Install no more than 50 addressable devices on each signaling line circuit.

2. Serial Interfaces: Two RS-232 ports for printers.

D. Stairwell Pressurization: Provide an output signal using an addressable relay to start the stairwell pressurization system. Signal shall remain on until alarm conditions are cleared and

fire-alarm system is reset. Signal shall not stop in response to alarm acknowledge or signal silence commands.

1. Pressurization starts when any alarm is received at fire-alarm control unit.
2. Alarm signals from smoke detectors at pressurization air supplies have a higher priority than other alarm signals that start the system.

E. Smoke-Alarm Verification:

1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
2. Activate an NRTL-listed and -approved "alarm-verification" sequence at fire-alarm control unit and detector.
3. Record events by the system printer.
4. Sound general alarm if the alarm is verified.
5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

F. Notification Appliance Circuit: Operation shall sound in a temporal.

G. Elevator Recall:

1. Smoke detectors at the following locations shall initiate automatic elevator recall. Alarm-initiating devices, except those listed, shall not start elevator recall.
   a. Elevator lobby detectors except the lobby detector on the designated floor.
   b. Smoke detector in elevator machine room.
   c. Smoke detectors in elevator hoistway.
2. Elevator lobby detectors located on the designated recall floors shall be programmed to move the cars to the alternate recall floor.
3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.
   a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.

1. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to fire-alarm system. Review Door Hardware Schedule for sequence of operation requiring an interface with the fire alarm system, such as release upon fire alarm. Provide all fire alarm system components to accomplish the specified sequence of operation which may require components beyond those that are indicated on drawings. Provide fire alarm release at all delayed egress doors and any other doors in the path of egress that are allowed to be locked.

H. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

I. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

J. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

K. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

L. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
1. Batteries: Sealed, valve-regulated, recombinant lead acid.

M. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key- or wrench-operated switch.
3. Indoor Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
4. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.5 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:
1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be four-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
   a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
   b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
   c. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
   a. Primary status.
   b. Device type.
   c. Present average value.

d. Present sensitivity selected.
e. Sensor range (normal, dirty, etc.).

C. Ionization Smoke Detector:
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
a. Primary status.
b. Device type.
c. Present average value.
d. Present sensitivity selected.
e. Sensor range (normal, dirty, etc.).

D. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
a. Primary status.
b. Device type.
c. Present average value.
d. Present sensitivity selected.
e. Sensor range (normal, dirty, etc.).

3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.
7. Remote Test Station (RTS): Provide keyed type RTS. Comply with NFPA 72, owner, AHJ, architect, and EOR locations.

2.6 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.
1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.7 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Individually addressed, connected to a signaling line circuit, equipped for mounting as indicated and with screw terminals for system connections.

B. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.
1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.

C. Chimes, Low-Level Output: Vibrating type, 75-dBA minimum rated output.

D. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.

E. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level

of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.

F. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.
1. Rated Light Output:
   a. 15/30/75/110 cd, selectable in the field.
2. Mounting: Wall mounted unless otherwise indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, white.

2.8 MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
1. Electromagnet: Requires no more than 3 W to develop 25-lbf (111-N) holding force.
2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
3. Rating: 24-V ac or dc.
4. Rating: 120-V ac.

B. Material and Finish: Match door hardware.

2.9 REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
1. Mounting: Flush cabinet, NEMA 250, Type 1.

B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.10 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.

B. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall to circuit-breaker shunt trip for power shutdown.

2.11 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:
1. Verification that both telephone lines are available.
2. Programming device.
3. LED display.

4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:
1. Address of the alarm-initiating device.
2. Address of the supervisory signal.
3. Address of the trouble-initiating device.
4. Loss of ac supply or loss of power.
5. Low battery.
6. Abnormal test signal.
7. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.12 SYSTEM PRINTER

A. Printer shall be listed and labeled by an NRTL as an integral part of fire-alarm system.

2.13 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
1. Factory fabricated and furnished by manufacturer of device.
2. Finish: Paint of color to match the protected device.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Comply with NFPA 72 for installation of fire-alarm equipment.

B. Install wall-mounted equipment, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.
1. Comply with requirements for seismic-restraint devices specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

C. Smoke- or Heat-Detector Spacing:
1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet (9 m).
4. HVAC: Locate detectors not closer than 3 feet (1 m) from air-supply diffuser or return-air opening.
5. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture.

D. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Install keyed remote test stations in acceptable locations.

E. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.

F. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

G. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.

H. Remote Test Station (RTS): Install keyed test station in wall near each duct smoke detector that is not readily visible from normal viewing position. Provide in locations acceptable to owner, AHJ, Architect, & EOR.

I. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

J. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling.

K. Device Location-Indicating Lights: Locate in public space near the device they monitor.

L. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

M. Annunciator: Install with top of panel not more than 72 inches (1830 mm) above the finished floor.

3.2 WIRING INSTALLATION

A. Wiring Method: Install wiring in metal raceway according to Division 26 Section 260519 Conceal raceway except in unfinished spaces and as indicated.

B. Wiring for Grid Ceiling Mounted Devices: Install junction box at accessible location above ceiling. Use flexible metal conduit for wiring between junction box and outlet box for ceiling mounted device. Secure flexible conduit within 12 inches of junction box.

C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by the manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

D. Cable Taps: Use numbered terminal strips in junction, pull and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

E. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

F. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signal from other floors or zones.

G. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the FACP and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.3 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.
   1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet (1 m) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
   1. Alarm-initiating connection to smoke-control system (smoke management) at firefighter smoke-control system panel.
   2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
   3. Smoke dampers in air ducts of designated air-conditioning duct systems. Provide end switches at each smoke and fire/smoke damper
   4. Alarm-initiating connection to elevator recall system and components.
   5. Alarm-initiating connection to activate emergency lighting control.
   6. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
   7. Supervisory connections at valve supervisory switches.
   8. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
   9. Supervisory connections at elevator shunt trip breaker.
   10. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
   11. Supervisory connections at fire-pump engine control panel.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.5 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.6 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:
   1. Visual Inspection: Conduct visual inspection prior to testing.
      a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
      b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
   2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION