PROJECT MANUAL June 2nd, 2021

Intermountain Healthcare Riverton Hospital

Station 8 Build Out
Intermountain Project # 10011367



JRCA Project No.: IHC00012.30

JRCA Architects, A Galloway Co.

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SECTION 00 2213 SUPPLEMENTARY INSTRUCTIONS TO BIDDERS

The Supplementary Instructions to Bidders herein describe, contain changes and additions to Section 00 0100 - Instructions to Bidders (included by reference - copies may be obtained from the Architect's office for the cost of reproduction). Where any part of the Instructions to Bidders is modified by these Supplementary instructions, the unaltered provisions shall remain in effect.

3.1.5 COPIES

Add the following:

The title or cover sheet to the drawings and the index to the Project Manual contains a list of all documents which comprise a full set of bid documents for this project. Any Contractor, Subcontractor, vendor or any other person participating in or bidding on this project shall be responsible for the information contained in any and all sheets of drawings and all sections of the specifications. If any person, party or entity elects to submit bids for any portion, or all, of this project, that person, party or entity shall be responsible for any and all information contained in these drawings and specifications, including, but not limited to, any subsequent addendums or clarifications that may be issued.

3.3 SUBSTITUTIONS

Amend 3.3.2 to read:

No substitution will be considered prior to receipt of Bids unless written request for approval has been received by the Architect at least 7 days prior to the date for receipt of Bids. Such requests...

3.4 ADDENDA

Amend 3.4.3 to read:

No addenda will be issued later than 24 hours prior to the date for receipt of Bids except an addendum may be issued no later than 12 hours prior to the date for receipt of bids for the purpose of cancellation or postponement of receipt of bids. It is the responsibility of the Bidder to disseminate telephone addendum information to sub-bidders.

4.2 BID SECURITY

Delete this article in its entirety. Bid bonds will not be required for this project.

4.3 SUBMISSION OF BIDS

Amend 4.3.4 to read:

Bids shall be hand delivered in sealed envelope or emailed to the Owner at the address noted in the Invitation to Bid. Bids submitted orally, or by telephone or facsimile will not be considered.

5.3 ACCEPTANCE OF BID (AWARD)

Amend 5.3.2 to read:

The Owner shall ... to determine the low bidder on the basis of the sum of the Base Bid or on the basis of the sum of the Base Bid and any combined accepted Alternates. Cost of insurance will not be used as the basis of award.

ARTICLE 7 - PERFORMANCE AND PAYMENT BOND

Delete this Article in its entirety. Bonds will not be required for this Project.

SECTION 00 3100 AVAILABLE PROJECT INFORMATION

PART 1 GENERAL

1.01 SUMMARY

- A. This Section references other information relevant to the construction of this Project that is available project information.
- B. At the request of the Owner the information identified below represents services that have been provided by others, not as an Architect's Consultant, regarding conditions that affect this Project that are beyond the responsibilities of the Architect and Architect's Consultants. Architect takes no representation, expressed or implied, as to the accuracy or validity of the information.

1.02 SITE EXAMINATION

- A. Bidders are expected to examine the site and the information available from the Owner to determine for themselves the conditions to be encountered.
- B. If conditions other than those indicated in the information available from the Owner are encountered before or during construction, notify the Owner before work continues.

1.03 INFORMATIONAL REPORTS

- A. Infection Control Risk Assessment Report:
 - The Owner's Risk Assessment Consultant has assessed the environmental impact of the work on the existing, adjacent healthcare functions, and has prepared an Infection Control Risk Assessment (ICRA) report that includes specific requirements of the Contractor.
 - 2. Copies are available from the Owner upon request.
 - 3. The IRCA establishes strategic infection control provisions and requirements for the purpose of controlling the dissemination of airborne micro-organism contaminants encountered or generated during the construction process through the use of containment protocols and environmental monitoring.
- B. Division 27 Communications" and Low Voltage + Network Structured Cable Specifications & Standards prepared by Intermountain Healthcare. Refer to Appendix A in Project Manual.

PART 2 PRODUCTS (NOT USED)
PART 3 EXECUTION (NOT USED)

SECTION 00 4000 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: Anna Lisa Silcox

Email: AnnaLisa.Silcox@imail.org

PROJECT: Intermountain Healthcare Primary Children's Eccles Station 8 Build-out

Intermountain Project# 10011367

Primary Children's Hospital 81 North Mario Capecchi Drive Salt Lake City, UT 84113

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 **JRCA Architects**.

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

BASE BID – for the Eccles Station 8 Build-out for Intermountain Healthcare

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 1 –	
	e contract listed above and shown on the Drawings as ALTERNATE 1 Manual, I/We agree to perform for the sum of:
CONTRACTOR'S PROPOSED	CONSTRUCTION TIME PERIOD:
ofcalendar	tion time in calendar days from the date of authorization days. Stantial Completion is thus, 2022.
ADDENDA:	
I/We acknowledge receipt of	the following addenda for the above noted project:///
SCHEDULE OF VALUES:	
	Bid Form our Schedule of Values (Section 00 4373) which reflects the this for Owner review of subcontractors that are being proposed for this
TYPE OF ORGANIZATION:	
(Corporation, Partnership, In	dividual, etc.)
SEAL (If a Corporation)	
Respectfully Submitted,	
	Name of Bidder
	Authorized Signature

SECTION 00 4373 SCHEDULE OF VALUES – BASE BID

NAME OF BIDDER:		
DATE:		

BASE BID - PCH ECCLES STATION 8 BUILD-OUT

DIV	TITLE	AMOUNT	\$/SQ. FT	COMMENTS
01	General Conditions	\$	\$	
02	Demolition	\$	\$	
02	Saw cut slab	\$	\$	
03	Concrete	\$	\$	
05	Steel	\$	\$	
06	Woods and Plastics	\$	\$	
08	Openings	\$	\$	
09	Finishes	\$	\$	
10	Specialties	\$	\$	
21	Fire Suppression	\$	\$	
22	Plumbing	\$	\$	
23	HVAC	\$	\$	
26	Electrical	\$	\$	
SUB	TOTAL	\$	\$	
OVE	RHEAD AND PROFIT	\$	\$	
TOT	AL COST	\$	\$	

SECTION 00 5200 OWNER/CONTRACTOR AGREEMENT

PART 1- GENERAL

- 1.01. SUMMARY
 - A. Intermountain Healthcare's 'CONTRACTOR AGREEMENT' (Stipulated Sum) for Construction between the Owner and General Contractor' where the basis of payment is a STIPULATED SUM, will *presumably* be used on this project. An electronic copy may be obtained from Intermountain Healthcare's Project Manager.



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. 5/17

Name of business or institution claiming exemption (purchaser)				Telephone number		
Construction Company (Claiming exemption for IHC Health Services, Inc.)				Enter Number		
Street address			City		State	ZIP Code
Construction Company Address			Enter City		Utah	ZIP
Authorized signature Name (please print)		Name (please print)		Title		
Enter Name				Enter Title		
Name of Seller or Supplier:					Date	
Enter the name of the Seller/Supplier				Enter Date		
Sales Tax License Number:	11990296-013-STC		Required for all exc	emptions marked	d 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 COMMISSIONKeep 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: IHC HEALTH SERVICES, INC.

Name of project: Intermountain Project Name

***** ■ Machinery and Equipment and Normal Operating Repair or Replacement Parts Used in a Manufacturing Facility, Mining Activity or Web Search Portal or 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 a Utah manufacturing facility described in SIC Codes 2000-3999; 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 between July 1, 2010 and June 30, 2014; in the operation of an electronic financial payment service described in NAICS Code 522320; 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).

***** ■ 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.

* ☐ Auto, Industrial Gas, or Drilling Equipment Manufacturer

I certify the machinery, equipment, normal operating or replacement parts are used or consumed in a manufacturing process as described in NAICS 336111 (Automotive Manufacturing), or 325120 (Industrial Gas Manufacturing) to manufacture hydrogen of the 2002 North American Industry Classifications Systems, or by a drilling equipment manufacturer as defined in Utah Code §59-12-102.

***** □ 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.

*****□ Steel Mill

I certify the rolls, rollers, refractory brick, electric motors or other replacement parts will be used in the furnaces, mills or ovens of a steel mill as described in Standard Industrial Classification (SIC) 3312.

***** ■ 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.	* 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 transport-
* 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.	ing telecommunications service. 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
★ Locomotive Fuel I certify this fuel will be used by a railroad in a locomotive engine.	payments will be accounted for as payments made under a financing arrangement.
*☐ 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.	☐ 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
★ 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	Corrective eyeglasses and contact lenses are taxable.) Out-of-State Construction Materials I certify this tangible personal property will be shipped out of state and will become part of real property located in a state that does not have a sales tax or allow credit for tax paid to 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.	Construction Materials Purchased for Airports I certify the construction materials are purchased by, on behalf of, or for the benefit of Salt Lake International Airport, or a new airport owned or operated by a city in Davis, Utah, Washington or Weber County. I further certify the construction materials will be installed or converted into real property owned by and located at the airport.
* 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.	☐ 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.
* 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.	☐ 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
★ 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.	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.
*☐ 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. ☐ 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	☐ 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.
for the production of media for commercial distribution.	

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

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

SECTION 00 7000 GENERAL CONDITIONS

PART 1 - GENERAL

- 1.01. SUMMARY
 - A. INTERMOUNTAIN HEALTHCARE GENERAL CONDITIONS Intermountain Healthcare General Conditions of the Contract for Construction to be furnished, as requested. Where any part of the General Conditions is modified, the unaltered provisions shall remain in effect. An electronic copy may be obtained from Intermountain Healthcare's Project Manager.

SECTION 01 1000 SUMMARY

PART 1 - GENERAL

1.01. PROJECT

- A. Project Name: Intermountain Primary Children's Eccles Station 8 Build Out
- B. Owner's Name: Intermountain Healthcare.
- C. Architect's Name: JRCA Architects a Galloway Co.
- D. The Project consists of the build-out of sixteen exam rooms, one consultation room, two vitals and intake areas, one seventeen person staff room, one twenty-five person staff room, a supplies area, and an equipment storage room.

1.02. CONTRACT DESCRIPTION

A. Contract Type: A single prime contract based on a Stipulated Price as described in Document 00 5200 – Owner-Contractor Agreement Form.

1.03. DESCRIPTION OF ALTERATIONS WORK

- A. Scope of alterations work is indicated on drawings.
- B. Plumbing: Alter existing system and add new construction, keeping existing in operation.
- C. HVAC: Alter existing system and add new construction, keeping existing in operation.
- D. Electrical Power and Lighting: Alter existing system and add new construction, keeping existing in operation.
- E. Fire Suppression Sprinklers: Alter existing system and add new construction, keeping existing in operation.
- F. Fire Alarm: Alter existing system and add new construction, keeping existing in operation.
- G. Security System: Alter existing system and add new construction, keeping existing in operation.

1.04. OWNER OCCUPANCY

- A. Owner intends to continue to occupy adjacent portions of the existing building during the entire construction period.
- B. Owner intends to occupy the Project upon Substantial Completion.
- C. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- D. Schedule the Work to accommodate Owner occupancy.

1.05. CONTRACTOR USE OF SITE AND PREMISES

- A. Construction Operations: Limited to areas noted on Drawings. Locate and conduct construction activities in ways that will limit disturbance to site.
- B. Provide access to and from site as required by law and by Owner:
 - Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
 - 2. Do not obstruct roadways, sidewalks, or other public ways without permit.
- C. Utility Outages and Shutdown:
 - Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7-days notice to Owner and authorities having jurisdiction.
 - 2. Prevent accidental disruption of utility services to other facilities.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

SECTION 01 2600 CONTRACT MODIFICATION PROCEDURES

PART 1- GENERAL

1.01. SUMMARY

 Section includes administrative and procedural requirements for handling and processing Contract

1.02. MODIFICATIONS.

A. MINOR CHANGES IN THE WORK

 Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on Architect's Form "Architect's Supplemental Instructions".

B. PROPOSAL REQUESTS

- Owner-Initiated Proposed Change: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time using Architect's Form "Proposed Change". If necessary, the description will include supplemental or revised Drawings and Specifications.
 - a. Proposed Changes issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 - b. Within time specified in Proposed Change or with reasonable promptness, when not otherwise specified, after receipt of Proposed Change, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - c. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - 2) Include costs of labor and supervision directly attributable to the change.
 - 3) Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - 4) Include updated Submittal Schedule showing effect of the change.
- Contractor-Initiated Proposed Change: If latent or changed conditions require
 modifications to the Contract, Contractor may initiate a claim by submitting a request for
 a change to Architect using Contractor's Standard Form.
 - a. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 - b. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - c. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - d. Include costs of labor and supervision directly attributable to the change.
 - e. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - f. Include updated Submittal Schedule showing effect of the change.

g. Comply with requirements in Division 01 Section "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.

C. ADMINISTRATIVE CHANGE ORDERS

- Allowance Adjustment: If applicable, see Division 01 Section "Allowances" for administrative procedures for preparation of Proposed Change for adjusting the Contract Sum to reflect actual costs of allowances.
- 2. Unit-Price Adjustment: If applicable, see Division 01 Section "Unit Prices" for administrative procedures for preparation of Proposed Change for adjusting the Contract Sum to reflect measured scope of unit price work.
- 3. Alternates: If applicable, see Division 01 Section "Alternates" for administrative procedures for preparation of Proposed Change for adjusting the Contract Sum to reflect measured scope of alternate work.

D. CHANGE ORDER PROCEDURES

 On Owner's approval of a Proposed Change, Architect will issue a Change Order for signatures of Owner and Contractor on Architects Form "Change Order".

E. CONSTRUCTION CHANGE DIRECTIVE

- Construction Change Directive: Architect may issue a Construction Change Directive
 on Architects Form "Construction Change Directive". Construction Change Directive
 instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a
 Change Order.
 - Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- 2. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
 - a. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (NOT USED)
PART 3 - EXECUTION (NOT USED)



CONDITIONAL WAIVER AND RELEASE UPON PROGRESS PAYMENT

TO:	IHC HEALTH SERVICES, INC. ("Owner		
FROM:		("Contractor")	
PROPERTY NAME:		("Property")	
PROPERTY LOCATION:			
CONTRACT DATE:			
INVOICE DATE/NUMBER:		("Invoice")	
INVOICE PERIOD:			
PAYMENT AMOUNT:	\$	("Payment Amount")	
CONTRACT AMOUNTS:	Original Contract Sum:	\$	
	Plus (Less) Approved Change Orders:	\$	
	Adjusted Contract Sum:	\$	
	Less Total Payments Received to Date (including this invoice):	\$	
	Outstanding Adjusted Contract Sum:	\$	

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, Preconstruction 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:

- Contractor endorses a check in the Payment Amount payable to Contractor or provides valid wire transfer or direct deposit instructions; and
- 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.

		, a	
		By:	
		Print Name:	
		Title:	
STATE OF UTAH)		
COUNTY OF)		
On the day of	, 20,	this instrument was acknowledged before me by	, the
(title) of,	a		
		·	
		Public Notary	



WAIVER AND RELEASE UPON FINAL PAYMENT

TO:	IHC HEALTH SERVICES, INC.	("Owner")
FROM:		("Contractor")
PROPERTY NAME:		("Property")
PROPERTY LOCATION:		\$00 Ox.10000
CONTRACT DATE:		
INVOICE DATE/NUMBER:		("Invoice")
INVOICE PERIOD:		
TOTAL PAYMENT AMOUNT:	\$	("Payment Amount")
CONTRACT AMOUNTS:	Original Contract Sum:	\$
	Plus (Less) Approved Change Orders:	s
	Adjusted Contract Sum:	s

Under this 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, Preconstruction 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:

- Contractor endorses a check in the Payment Amount payable to Contractor or provides valid wire transfer or direct deposit instructions; and
- 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.

		By:	
		Title:	
STATE OF UTAH)		
COUNTY OF)		
On the day of, a _	, 20	, this instrument was acknowledged before me by	, the
		Public Notary	

SECTION 01 3100 PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.01. SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - General coordination procedures.
 - 2. Coordination drawings.
 - 3. Requests for Information (RFIs).
 - 4. Project Web site.
 - 5. Project meetings.

1.02. DEFINITIONS

- A. Project communications documents shall be defined as the following:
 - 1. Letters.
 - Memoranda.
 - 3. E-Mail Communications/Internet Communications/Project Management Software Communications.
 - 4. RFI (Request for Information Contractor).
 - 5. RFI-A (Request for Information Architect).

1.03. FORMAT

- A. Letters and Memoranda: Submit in formats acceptable to the Architect.
- B. E-Mail Communications/Internet Communications/Project Management Software Communications: Submit in forms and formats acceptable to and as approved by the Architect.
- C. RFI (Request for Information Contractor): Submit on forms furnished by the Architect, or on other forms as approved by the Architect.
- D. RFI-A (Request for Information Architect), will be submitted by Architect to Contractor on Architects standard form.

1.04. PROJECT COMMUNICATIONS DOCUMENTS

- A. Letters and Memoranda documents shall be submitted in a timely manner so as to facilitate project delivery and coordination. Routing of communications shall be as established in the Contract, the Contract Documents and the Pre-Construction Conference. Communications documents shall be transmitted or forwarded in a manner consistent with the schedule and progress of the work.
- B. E-Mail Communications, Internet Communications, and Project Management Software programs must be compatible with the Architect's and Owner's computer systems and equipment. The responsibility for all costs for management of these systems, including, but not limited to, licensing, onsite training or other training necessary for the proper operation of such systems, shall be by the Contractor. The Contractor shall keep written records and hard file copies of all electronic communications. Failure of the Contractor to keep such records shall waive the Contractor's right to rely on such communications and such communications shall be deemed to have not taken place.
- C. RFI (Request for Information Contractor) shall be defined and limited to a request from the Contractor seeking interpretation or clarification of the requirements of the Contract Documents. Such requests shall comply with the following requirements:
- D. RFI requests shall be submitted in a timely manner, well in advance of related work, and allow sufficient time for the resolution of issues relating to the request for interpretation or clarification. Contractor shall schedule the submission of RFI's so as to moderate and manage the flow of RFI requests. RFI's shall be submitted in a manner consistent with the schedule and progress of the work, and shall not be submitted in a sporadic and/or excessive manner.

- RFI requests shall be numbered in a sequential manner and contain a detailed description of the areas of work requiring interpretation or clarification. Include drawing and specification references, sketches, technical data, brochures, or other supporting data as deemed necessary by the Architect, for the Architect to provide the interpretations and clarifications requested.
 - a. The Contractor shall include a "Proposed Solution" to the issue requiring interpretation or clarification.
- 2. RFI's submitted to the Contractor by Sub-Contractors, vendors, suppliers, or other parties to the work shall be reviewed by the Contractor prior to submission to the Architect. If the Architect deems that such RFI requests have not been adequately reviewed by the Contractor, such requests will be returned to the Contractor for further action. Sub-Contractor's RFI shall contain a "Proposed Solution".
- 3. RFI requests shall not contain submittals, substitutions requests, routine communications, correspondence, memos, claims, or any information required by other areas of the Contract Documents. RFI requests containing such information will be returned to the Contractor without action by the Architect.
- 4. RFI requests are limited to a request for interpretation or clarification of the requirements of the Contract Documents. Interpretations provided by the Architect shall not change the requirements of the Contract or the Contract Documents. If the Contractor determines that the Architect's response to an RFI gives cause for a change in the Contract or the Contract Documents, the Contractor shall promptly, within 5 working days, give written notice to the Architect of request for adjustments. Requests for adjustments to the Contract shall be submitted in a manner consistent with the terms and conditions of the Contract Documents.
- 5. If the Architect, after review, determines that any RFI has been submitted in an incomplete manner, is unnecessary, or does not otherwise comply with the requirements of this Section, the RFI will be returned without action to the Contractor. The Contractor shall delete the original submittal date from the RFI log and enter a new submittal date at the time of re-submittal.
- 6. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Use software log that is part of Project Web site. Software log with not less than the following: a. Project name.
 - Name and address of Contractor.
 - b. Name and address of Architect.
 - c. RFI number including RFIs that were returned without action or withdrawn.
 - d. RFI description.
 - e. Date the RFI was submitted.
 - f. Date Architect's response was received.
 - g. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
 - h. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
- E. RFI-A (Request for Information Architect) shall be defined as a request by the Architect for information relating to the obligations of the Contractor under the Contract.
 - After receipt of an RFI-A the Contractor shall provide a written response to the Architect within 5 working days. Responses shall be thorough, complete and shall contain all information requested by the Architect.
 - An RFI-A shall be limited to a request by the Architect for information related to the project. The RFIA shall not be construed as authorizing or directing a change in the Contract or the Contract Documents.
- F. Revisions to Construction Documents: Responses to requests for information (RFI) shall not serve as construction documents; and the Contractor shall not incorporate RFI responses

into construction of the Project, unless such answers bear the seal and signature of a licensed design professional.

1.05. INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
 - 1) Post copies of list in project meeting room, in temporary field office, and Project Web site. Keep list current at all times.

1.06. GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
 - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 - 1. Preparation of Contractor's construction schedule.
 - 2. Preparation of the schedule of values.
 - 3. Installation and removal of temporary facilities and controls.
 - Delivery and processing of submittals.
 - 5. Progress meetings.
 - 6. Preinstallation conferences.
 - 7. Project closeout activities.
 - 8. Startup and adjustment of systems.
- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

1.07. COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is

- required to facilitate integration of products and materials fabricated or installed by more than one entity
- B. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - 1. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - 2. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - 3. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - 4. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - 5. Indicate required installation sequences.
 - Indicate dimensions shown on the Drawings. Specifically note dimensions that appear
 to be in conflict with submitted equipment and minimum clearance requirements.
 Provide alternate sketches to Architect indicating proposed resolution of such conflicts.
 Minor dimension changes and difficult installations will not be considered changes to
 the Contract.
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
 - 1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
 - 2. File Submittal Format: Submit or post coordination drawing files using Portable Data File (PDF) format.
 - 3. BIM File Incorporation: When applicable, develop coordination drawing files from Building Information Model (BIM) established for Project.
 - a. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Architect.
 - 4. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
 - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - b. Digital Data Software Program: Drawings are available in Autodesk Revit and/or Autocad; and compatible with Microsoft Windows operating system.
 - c. Contractor shall execute a data licensing agreement in the form of AIA Document C106.

1.08. PROJECT MEETINGS

- General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
 - Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 - 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 - 3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within 3 days of the meeting.
 - 4. Attendance: Document attendance of all participants.
- B. Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction.

- 1. Conduct the conference to review responsibilities and personnel assignments.
- Attendees: Authorized representatives of Owner, Architect, and their consultants;
 Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
 - Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, and coordination with adjacent activities. Prepare agenda appropriate to Work.
 - 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 - 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 - 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, at a time to be decided prior to the scheduled date of Substantial Completion.
 - Conduct the conference to review requirements and responsibilities related to Project closeout.
 - 2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of record documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Submittal of written warranties.
 - d. If applicable, requirements for completing sustainable design documentation.
 - e. Requirements for preparing operations and maintenance data.
 - f. Requirements for delivery of material samples, attic stock, and spare parts.
 - g. Requirements for demonstration and training.
 - h. Preparation of Contractor's punch list.
 - i. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - j. Submittal procedures.
 - k. If applicable, coordination of separate contracts.
 - I. If applicable, Owner's partial occupancy requirements.
 - m. Installation of Owner's furniture, fixtures, and equipment.
 - n. Responsibility for removing temporary facilities and controls.
 - . Minutes: Entity conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: Conduct progress meetings at regular intervals.
 - 1. Coordinate dates of meetings with preparation of payment requests.

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

 Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - b. Review schedule for next period.
 - Review present and future needs of each entity present, including the following or as needed:
 - (a) Interface requirements.
 - (b) Sequence of operations.
 - (c) If applicable, resolution of BIM component conflicts.
 - (d) Status of submittals.
 - (e) If applicable, status of sustainable design documentation.
 - (f) Deliveries.
 - (g) Off-site fabrication.
 - (h) Access.
 - (i) Site utilization.
 - (j) Temporary facilities and controls.
 - (k) Work hours.
 - (I) Hazards and risks.
 - (m) Progress cleaning.
 - (n) Quality and work standards.
 - (o) Status of correction of deficient items.
 - (p) Field observations.
 - (q) Status of RFIs.
 - (r) Status of proposal requests.
 - (s) Pending changes.
 - (t) Status of Change Orders.
 - (u) Documentation of information for payment requests.
 - 2) Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
 - (a) Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
- F. Coordination Meetings: Conduct Project coordination meetings on an as-needed basis. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
 - 1. Attendees: Each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future

- activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
- 2. Agenda: Review items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Review present and future needs of each contractor present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) If applicable, resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) Deliveries.
 - 6) Off-site fabrication.
 - 7) Access.
 - 8) Site utilization.
 - 9) Temporary facilities and controls.
 - 10) Work hours.
 - 11) Hazards and risks.
 - 12) Progress cleaning.
 - 13) Quality and work standards.
 - 14) Change Orders.

PART 2 - PRODUCTS (NOT USED)
PART 3 - EXECUTION (NOT USED)

SECTION 01 3200 CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.01. SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work.
- B. Related Section:
 - 1. Provide Construction Photographs in accordance with Division 01 Section "Photographic Documentation".

1.02. DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. Major Area: A story of construction, a separate building, or a similar significant construction element.
- C. Milestone: A key or critical point in time for reference or measurement.
- D. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- E. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- F. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.
- G. Event: The starting or ending point of an activity.
- H. Float: The measure of leeway in starting and completing an activity.
 - Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a
 jointly owned, expiring Project resource available to both parties as needed to meet
 schedule milestones and Contract completion date.
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- I. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.

1.03. SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. PDF electronic file.
- B. Startup construction schedule.
- C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
- E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.

- Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
- 2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by
- 1.04. ACTIVITY NUMBER AND THEN EARLY START DATE, OR ACTUAL START DATE IF KNOWN.
 - A. Total Float Report: List of all activities sorted in ascending order of total float.
 - B. Earnings Report: Compilation of Contractor's total earnings from the Notice to Proceed until most recent Application for Payment.
 - C. Construction Schedule Updating Reports: Submit with Applications for Payment.
 - D. Daily Construction Reports: Submit at weekly intervals.
 - E. Material Location Reports: Submit at monthly intervals.
 - F. Site Condition Reports: Submit at time of discovery of differing conditions.
 - G. Special Reports: Submit at time of unusual event.

1.05. COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.
- B. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
- C. Secure time commitments for performing critical elements of the Work from entities involved.
- D. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.01. CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of final completion.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 - 1. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 - Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
 - 3. Startup and Testing Time: Include no fewer than 7 days for startup and testing.
 - 4. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
 - 5. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule (where applicable), and show how the sequence of the Work is affected.
 - 1. Phasing: Arrange list of activities on schedule by phase.
 - Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 - 3. Products Ordered in Advance: Include a separate activity for each product.
 - 4. Owner-Furnished Products: Include a separate activity for each product.

- 5. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use of premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.
- 6. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Mockups.
 - e. Fabrication.
 - f. Sample testing.
 - g. Deliveries.
 - h. Installation.
 - i. Tests and inspections.
 - j. Adjusting.
 - k. Curing.
 - I. Building flush-out.
 - m. Startup and placement into final use and operation.
- 7. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
 - Structural completion.
 - b. Temporary enclosure and space conditioning.
 - c. Permanent space enclosure.
 - d. Completion of mechanical installation.
 - e. Completion of electrical installation.
 - Substantial Completion.
- 8. Other Constraints include but are not limited to the following:
 - a. Roads.
 - b. Parking.
 - c. Landscape.
- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, punch list activities, Substantial Completion, and final completion.
- E. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.
- F. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

2.02. STARTUP CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Submit startup, horizontal, bar-chart-type construction schedule within 14 days of date established for the Notice of Award.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 60 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- C. Startup Network Diagram may be submitted in lieu of Bar-Chart Schedule.

2.03. CONTRACTOR'S CONSTRUCTION SCHEDULE (BAR CHART/GANTT CHART)

- A. Bar Chart/Gantt Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart type, Contractor's construction schedule within 30 days of date established for the Notice to Proceed. Base schedule on the startup construction schedule and additional information received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
 - 1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

2.04. CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. Startup Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 60 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- C. CPM Schedule: Prepare Contractor's construction schedule using a time-scaled CPM network analysis diagram for the Work.
 - 1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 30 days after date established for the Notice to Proceed.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.
 - Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
 - 3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 - 4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule in order to coordinate with the Contract Time.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
 - 1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Purchase of materials.
 - c. Delivery.
 - d. Fabrication.
 - e. Installation.
 - f. Punch list and final completion.
 - 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with

Contract milestone dates. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.

- 3. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment, fragnet, to demonstrate the effect of the proposed change on the overall project schedule.
- F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
 - 1. Contractor or subcontractor and the Work or activity.
 - 2. Description of activity.
 - 3. Main events of activity.
 - 4. Immediate preceding and succeeding activities.
 - 5. Early and late start dates.
 - Early and late finish dates.
 - 7. Activity duration in workdays.
 - Total float or slack time.
 - 9. Average size of workforce.
 - 10. Dollar value of activity (coordinated with the schedule of values).
- G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
 - 1. Identification of activities that have changed.
 - 2. Changes in early and late start dates.
 - 3. Changes in early and late finish dates.
 - 4. Changes in activity durations in workdays.
 - 5. Changes in the critical path.
 - 6. Changes in total float or slack time.
 - 7. Changes in the Contract Time.
- H. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.
 - 1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
 - 2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
 - 3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
 - Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
 - a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
 - b. Submit value summary printouts one week before each regularly scheduled progress meeting.

2.05. REPORTS

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

- 2. List of separate contractors at Project site.
- Approximate count of personnel at Project site.
- High and low temperatures and general weather conditions, including presence of rain or snow.
- Accidents.
- 6. Meetings and significant decisions.
- 7. Unusual events (see special reports).
- 8. Stoppages, delays, shortages, and losses.
- 9. Meter readings and similar recordings.
- 10. Emergency procedures.
- 11. Orders and requests of authorities having jurisdiction.
- 12. Change Orders received and implemented.
- 13. Construction Change Directives received and implemented.
- 14. Services connected and disconnected.
- 15. Equipment or system tests and startups.
- 16. Partial completions and occupancies.
- 17. Substantial Completions authorized.
- B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.
- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.06. SPECIAL REPORTS

- A. General: Submit special reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.
- B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.01. CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting using CPM scheduling.
- B. In-House Option: Owner may waive the requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.
 - Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.
- C. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
 - Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.

- 3. As the Work progresses, indicate final completion percentage for each activity.
- D. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 - 1. Post copies in Project meeting rooms and temporary field offices.
 - When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

3.02. CONSTRUCTION PHOTOGRAPHS

- A. Minimum Digital Camera Resolution: 1800 x 1200 dpi (dots per inch) @ 72 dpi resolution.
- B. Approved Electronic File Format: .jpg, .tif., .tiff., .tga., jpe., or .png.
- C. Date Stamp: Unless otherwise indicated, date and time stamp each photograph as it is being taken so stamp is integral to photograph.
- D. Image File Naming Convention (separate by an underscore):
 - 1. Project Job Number / Year-Month-Day / Image Number. file extension
- E. Preconstruction Photographs: Before starting construction, take 4 photographs of Project site and surrounding properties from different vantage points, as directed by Architect. Show existing conditions adjacent to property. Submit prints and CD ROMs with digital files as required under "Submittals" Article.
- F. Periodic Construction Photographs: Take 8 photographs monthly, coinciding with cutoff date associated with each Application for Payment. Photographer shall select vantage points to best show status of construction and progress since last photographs were taken. Submit prints and CD ROMs with digital files as required under "Submittals" Article.
 - 1. Field Office Prints: In addition to prints required to be submitted under "Submittals" Article, make and retain in field office at Project site available at all times for reference, one set of prints of periodic construction photographs. Identify photographs the same as for those submitted to Architect.
- G. Final Completion Construction Photographs: Take 12 photographs after date of Substantial Completion for submission as Project Record Documents. Architect will direct photographer for desired vantage points. Submit prints and CD ROMs with digital files as required under "Submittals" Article.

SECTION 01 400 QUALITY REQUIREMENTS

PART 1 - GENERAL

1.01. SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - Specified tests, inspections, and related actions do not limit Contractor's other qualityassurance and control procedures that facilitate compliance with the Contract Document requirements.
 - Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.02. DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- D. Product Testing: Tests and inspections that are performed by an NRTL (Nationally Recognized Testing Laboratories), an NVLAP (National Voluntary Laboratory Accreditation Program), or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- E. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- H. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- I. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction and with the qualification requirements of individual specification section governing their work.

1.03. CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.04. CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's qualityassurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
 - 1. Project quality-control manager may be the Project superintendent or be an individual with no other Project responsibilities, as accepted by the Architect.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
 - Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
 - 2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
 - 3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by the Commissioning Authority when Commissioning is included in the Project.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results, including Owner acceptance of nonconforming work. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.05. REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, and telephone number of testing agency.
 - 4. Dates and locations of samples and tests or inspections.

- 5. Names of individuals making tests and inspections.
- 6. Description of the Work and test and inspection method.
- 7. Identification of product and Specification Section.
- 8. Complete test or inspection data.
- 9. Test and inspection results and an interpretation of test results.
- 10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
- 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
- 12. Name and signature of laboratory inspector.
- 13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
 - 1. Name, address, and telephone number of technical representative making report.
 - 2. Statement on condition of substrates and their acceptability for installation of product.
 - 3. Statement that products at Project site comply with requirements.
 - 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 - 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 - 6. Statement whether conditions, products, and installation will affect warranty.
 - 7. Statement whether conditions, products, and installation exceed manufacturer's statements.
 - 8. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections.

1.06. INCLUDE THE FOLLOWING:

- A. Name, address, and telephone number of factory-authorized service representative making report.
- B. Statement that equipment complies with requirements.
- C. Results of operational and other tests and a statement of whether observed performance complies with requirements.
- D. Statement whether conditions, products, and installation will affect warranty.
- E. Other required items indicated in individual Specification Sections.
- F. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.07. QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
 - 1) Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
 - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
 - 1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
 - e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.
 - 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- K. Mock-ups: Prior to fabrication and installation, build mock-up for each form of construction and finish required to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mock-up to comply with the following requirements, using materials indicated for the completed Work:

- 1. Build mock-up in the location and of the size indicated or, if not indicated, as directed by Architect. Contractor shall provide structural support framework.
 - Show typical components, attachments to building structure, and requirements of installation.
- 2. Clean exposed faces of mock-up.
- Notify Architect seven days in advance of the dates and times when mock-up will be installed.
- 4. Demonstrate the proposed range of aesthetic effects and workmanship.
- 5. Protect accepted mock-up from the elements with weather-resistant membrane.
- 6. Obtain Architect's acceptance of mock-ups before starting fabrication.
- 7. Maintain mock-ups during construction in an undisturbed condition as a standard for review of the completed Work.
- 8. Acceptance of mock-ups does not constitute acceptance of deviations from the Contract Documents contained in mock-ups unless such deviations are specifically noted by Contractor, submitted to Architect in writing, and accepted by Architect in writing.
- 9. Demolish and remove mock-ups when directed by Architect unless accepted to become part of the completed Work.

1.08. QUALITY CONTROL

- Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
 - 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 - 2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.
 - 3. The owner will contract with a vendor to provide the third-party testing and inspection of:
 - a. Soils density/moisture relationships, gradation, and Atterberg limits
 - b. Concrete compressive strength testing
 - c. Asphalt tests (Marshall)
 - d. Fireproofing thickness/adhesion, density
 - e. Structural steel magnetic particle testing, ultrasonic inspection, field welding, high strength bolt/metal decking inspection, radiographic inspection
 - f. Radiation protection shielding
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
 - 1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 - 2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 - 3. Notify testing agencies at least 48 hours in advance of time when Work that requires testing or inspecting will be performed.
 - 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 - 5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.

- Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."
- D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- F. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
 - 1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 - 2. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 - 3. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control

1.09. SERVICE THROUGH CONTRACTOR.

- A. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
- B. Do not perform any duties of Contractor.
- C. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
 - 1. Access to the Work.
 - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 - 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 - 4. Facilities for storage and field curing of test samples.
 - 5. Delivery of samples to testing agencies.
 - 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 - 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- D. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
 - 1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- E. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's construction schedule.
 - 1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.
 - 2. Prepare in tabular form and include the following:

- a. Specification Section number and title.
- b. Entity responsible for performing tests and inspections.
- c. Description of test and inspection.
- d. Identification of applicable standards.
- e. Identification of test and inspection methods.
- f. Number of tests and inspections required.
- g. Time schedule or time span for tests and inspections.
- h. Requirements for obtaining samples.
- i. Unique characteristics of each quality-control service.

1.10. SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner may engage a qualified to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:
 - 1. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 - 2. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
 - 3. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 - 4. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 - 5. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01. TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
 - 1. Date test or inspection was conducted.
 - 2. Description of the Work tested or inspected.
 - 3. Date test or inspection results were transmitted to Architect.
 - 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.02. REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
 - Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas in a manner that eliminates evidence of patching. Comply with the Contract Document requirements for cutting and patching in Division 01 Section "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality control services.

SECTION 01 5000 TEMPORARY FACILITIES AND CONTROLS

PART 1 – GENERAL

1.01. SUMMARY

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

1.02. INFORMATIONAL SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- B. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.
 - 1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
 - 2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
 - 3. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
- C. Dust- and HVAC-Control Plan at Renovation Work: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:
 - 1. Locations of dust-control partitions at each phase of work.
 - 2. HVAC system isolation schematic drawing.
 - 3. Location of proposed air-filtration system discharge.
 - 4. Waste handling procedures.
 - Other dust-control measures.
- D. Temporary Utility Reports: Make available on request, reports of tests, inspections, meter readings, and similar procedures performed on temporary utilities.
- E. Implementation and Termination Schedule: Make available on request a schedule indicating implementation and termination of each temporary utility.

1.03. QUALITY ASSURANCE

- A. Standards: Comply with ANSI A10.6 "Requirements for Demolition Operations", NECA's "Temporary Electrical Facilities," and NFPA 241 "Standard for Safeguarding Construction, Alteration, and Demolition Operations".
 - 1. Trade Jurisdictions: Assigned responsibilities for installation and operation of temporary utilities are not intended to interfere with trade regulations and union jurisdictions.
- B. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- C. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- D. Accessible Temporary Egress at Renovation Work: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.
- E. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction, including but not limited to, the following:
 - Building Code requirements.
 - Health and safety regulations.
 - 3. Utility company regulations.

- 4. Police, Fire Department and Rescue Squad rules.
- 5. Environmental protection regulations.
- 6. City ordinances and regulations.
- F. Owners Work Permit: Comply with all requirements outlined within the Infection Control Risk Assessment provided by Intermountain Healthcare. Refer to appendix for complete report.

1.04. PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.01. MATERIALS

- A. General: Provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved by Architect. Provide materials suitable for use intended.
- B. Polyethylene Sheet: Reinforced, fire-resistive sheet, 6 mil (0.14 mm) minimum thickness, with Class A flamespread rating per ASTM E 84 and passing NFPA 701 Test Method 2.
 - Basis of Design (Product Standard): Abatement Technologies, Inc.; SAFE-FLEX ICRA Awareness Barrier.
- C. Dust Containment Barrier for Temporary Partitions: 1/8"x4'-0"x8'-0" Eucalyptus White Hardboard.
- D. Dust-Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches (900 by 1500 mm).
- E. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

2.02. TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
- C. Store combustible materials apart from building.

2.03. EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
 - 1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.
- B. Self-Contained Toilet Units: Single-occupant units of chemical, aerated recirculation, or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.
- C. Drinking-Water Fixtures: Containerized, tap-dispenser, bottled-water drinking-water units, including paper cup supply.
- D. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction and marked for intended location and application.
- E. Air-Filtration Units for Renovation Work: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.01. 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.

3.02. TEMPORARY UTILITY INSTALLATION

- A. Locate temporary utilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify utilities as required.
- B. Provide each utility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until utilities are no longer needed or are replaced by authorized use of completed permanent utilities.
- C. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
 - Existing Toilets in Occupied Facilities: Use of Owner's existing toilet facilities will not be permitted or allowed.
- D. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- E. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
 - 1. Prior to commencing work, isolate the HVAC system in area where work is to be performed according to coordination drawings.
 - Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
 - b. Maintain negative air pressure within work area using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
 - 2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
 - 3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.
- F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
 - 1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
- G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

3.03. SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
 - 1. Locate field offices, storage sheds, sanitary facilities, and other temporary construction and support facilities for easy access.
 - 2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial

Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

- B. Parking: Coordinated parking with Owner's requirements.
- C. Project Signs: Coordinated signs with Owner's requirements and requirements of authorities having jurisdiction.
- D. Waste Disposal Facilities: Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."
- E. Comply with progress cleaning requirements in Division 01 Section "Execution."
- F. Existing Elevator Use in Occupied Facilities: Use of Owner's existing elevators will be permitted, provided elevators are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore elevators to condition existing before initial use, including replacing worn cables, guide shoes, and similar items of limited life.
 - 1. Do not load elevators beyond their rated weight capacity.
 - 2. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work so no evidence remains of correction work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.
- G. Existing Stair Usage in Occupied Facilities: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.
 - 1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.

3.04. SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
- B. Infection Control Risk Assessment Requirements: Operate temporary facilities, construct temporary containment barriers and in all other ways comply with Infection Control Risk Assessment Report. The Infection Control Risk Assessment Report includes specific requirements of the Contractor.
- C. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
 - 1. Comply with work restrictions specified in Division 01 Section "Summary."
- D. ree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- E. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.
 - Owner has indicated the Contractor will encounter roaches during the course of construction. All measures shall be taken to ensure pest are remediated prior to general construction activity and avoid creation of pathways for migration to nearby existing conditions
- F. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- G. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

- H. Temporary Enclosures: Provide temporary, weathertight, enclosures for protection of construction, in progress and completed, including, but not limited to, vertical and horizontal openings, from exposure, foul weather, other construction operations, and similar activities.
- I. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas from fumes and noise.
 - 1. Construct dustproof partitions with 1/2"x4'x8' Eucalyptus White Hardboard with joints taped on occupied side, and fire retardant-treated plywood on construction operations side.
 - a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches (1200 mm) between doors. Maintain walk-off mats in vestibule, for dust control.
 - 2. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
 - 3. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
 - 4. Protect air-handling equipment.
 - 5. Provide walk-off mats at each entrance through temporary partition.
 - 6. Coordinate partition location with the Contract Documents, confirm locations with Owner prior to construction to ensure existing operations are maintained.
- J. 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 and authorities having jurisdiction; manage fire-prevention program.

3.05. MOISTURE CONTROL

- A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of discoloration that may appear during construction.
- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure, protect as follows:
 - 1. Protect porous materials from water damage.
 - 2. Protect stored and installed material from flowing or standing water.
 - 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 - 4. Remove standing water from decks.
 - 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture, protect as follows:
 - 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 - 2. Keep interior spaces reasonably clean and protected from water damage.
 - 3. Periodically collect and remove waste containing cellulose or other organic matter.
 - 4. Discard or replace water-damaged material.
 - 5. Do not install material that is wet.
 - 6. Discard, replace, or clean stored or installed material that begins to show discoloration.
 - 7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
 - 1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 - 2. Use permanent HVAC system to control humidity.
 - Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits. Refer to technical specification sections for additional and more stringent criteria.

3.06. OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
 - Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 - 1. Materials and facilities that constitute temporary facilities are property of Contractor.
 - 2. Remove temporary roads and paved areas not intended for or approved for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
 - At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

SECTION 01 6000 PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- General product requirements.
- B. Transportation, handling, storage and protection.
- C. Substitution limitations and procedures.
- D. Procedures for Owner-supplied products.
- E. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS

- A. Section 01 4000 Quality Requirements: Product quality monitoring.
- B. Section 01 7419 Construction Waste Management and Disposal: Waste disposal requirements potentially affecting packaging and substitutions.

1.03 REFERENCE STANDARDS

- A. EN 15804 Sustainability of construction works Environmental product declarations Core rules for the product category of construction products; 2013.
- B. NFPA 70 National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

PART 2 PRODUCTS

2.01 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by the Contract Documents.
- B. DO NOT USE products having any of the following characteristics:
 - 1. Made using or containing CFC's or HCFC's.
 - 2. Containing lead, cadmium, asbestos.
- C. Where all other criteria are met, Contractor shall give preference to products that:
 - 1. Have longer documented life span under normal use.
 - 2. Result in less construction waste.
 - 3. Are made of recycled materials.
- D. Provide interchangeable components of the same manufacture for components being replaced.

2.02 MAINTENANCE MATERIALS

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

PART 3 EXECUTION

3.01 SUBSTITUTION PROCEDURES

- A. Instructions to Bidders specify time restrictions for submitting requests for substitutions during the bidding period. Comply with requirements specified in this section.
- B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.
- C. A request for substitution constitutes a representation that the submitter:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
 - 2. Will provide the same warranty for the substitution as for the specified product.
 - 3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.

- Waives claims for additional costs or time extension that may subsequently become apparent.
- 5. Will reimburse Owner and Architect for review or redesign services associated with reapproval by authorities.
- D. 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.
- E. Substitution Submittal Procedure:
 - 1. Submit three copies of request for substitution for consideration. Limit each request to one proposed substitution.
 - 2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
 - 3. The Architect will notify Contractor in writing of decision to accept or reject request.

3.02 OWNER-SUPPLIED PRODUCTS

- A. Owner's Responsibilities:
 - Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
 - 2. Arrange and pay for product delivery to site.
 - 3. On delivery, inspect products jointly with Contractor.
 - 4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
 - 5. Arrange for manufacturers' warranties, inspections, and service.
- B. Contractor's Responsibilities:
 - 1. Review Owner reviewed shop drawings, product data, and samples.
 - 2. Receive and unload products at site; inspect for completeness or damage jointly with Owner
 - 3. Handle, store, install and finish products.
 - Repair or replace items damaged after receipt.

3.03 TRANSPORTATION AND HANDLING

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

3.04 STORAGE AND PROTECTION

- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.

- D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- G. Comply with manufacturer's warranty conditions, if any.
- H. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- I. Prevent contact with material that may cause corrosion, discoloration, or staining.
- J. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- K. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

SECTION 01 7300 EXECUTION

PART 1 - GENERAL

1.01. SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Coordination of Owner-installed products.
 - 6. Progress cleaning.
 - 7. Starting and adjusting.
 - 8. Protection of installed construction.
 - Correction of the Work.

1.02. DEFINITIONS

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

1.03. SUBMITTALS

- A. Qualification Data: For land surveyor or professional engineer.
- B. Certificates: Submit certificate signed by land surveyor or professional engineer certifying that location and elevation of improvements comply with requirements.
- C. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
 - 1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
 - Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
 - 3. Products: List products to be used for patching and firms or entities that will perform patching work.
 - 4. Dates: Indicate when cutting and patching will be performed.
 - 5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
 - a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.
 - 6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
 - 7. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.
- D. Retention System Certification: Submit a statement certified by the Contractor's registered structural engineer that the design of components of the excavation support system is in compliance with provisions of the Contract Documents and the local building code, and is in keeping with generally accepted engineering practice.

- 1. Submit, if requested, design calculations, specifications and erection drawings, bearing the Contractor's registered structural engineer's stamp, to the local building code official.
- 2. Submit complete excavation support system shop drawings for information coordination purposes only.
- 3. Architect/Engineer will neither review nor approve excavation support system shop drawings.

1.04. QUALITY ASSURANCE

- A. Retention System Engineering: Each component of the excavation support system shall be designed by a registered structural engineer, in accordance with the local building code, and registered structural engineer shall be engaged by the Contractor.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 - 1. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection
 - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
 - 3. Miscellaneous Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
 - 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
 - a. If possible, retain original Installer or fabricator to cut and patch exposed Work listed below. If it is impossible to engage original Installer or fabricator, engage another recognized, experienced, and specialized firm.
- C. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.
- D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

1.05. WARRANTY

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

PART 2 - PRODUCTS

2.01. MATERIALS

- A. General: Comply with requirements specified in other Sections.
 - 1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with requirements in Division 01 sustainable construction requirements Section.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.01. EXAMINATION

- A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
 - 1. Before construction, verify the location and points of connection of utility services.
- B. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

3.02. INSTALLATION, GENERAL

- A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:
 - 1. Respective manufacturer/fabricator's written installation instructions.
 - 2. Accepted submittals.
 - 3. Contract Documents.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

3.03. PREPARATION

- A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.
- B. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- C. Existing Utility Interruptions at Renovation Work: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Owner not less than 72 hours in advance of proposed utility interruptions.
 - Do not proceed with utility interruptions without Owner's written permission.
- D. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- E. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- F. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Division 01 Section "Project Management and Coordination."

3.04. CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- C. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.05. INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated, unless indicated otherwise in the Contract Documents.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located, aligned, and coordinated with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.06. CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching.

 Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Division 01 Section "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer: comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
 - Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - p. Restore damaged pipe covering to its original condition.
 - 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

- b. Patch fire rated assemblies with materials to match existing and maintain assembly fire rating.
- 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an evenplane surface of uniform appearance.
- 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.07. OWNER-INSTALLED PRODUCTS

- A. Site Access: As applicable, provide access to Project site for Owner's construction personnel.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
 - Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 - 2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.08. PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold waste materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F (27 deg C).
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste.

 Mark containers appropriately and dispose of legally, according to regulations.
 - Use containers specifically intended for holding types of waste materials identified where applicable, e.g. blue colored containers with labeling and symbols for biowaste.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills immediately.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Division 01 Section "Temporary Facilities and Controls." and Division 01 Section "Construction Waste Management and Disposal", whichever is the more restrictive.

- H. Remove construction markings not required and graffiti immediately, repairing or replacing damaged material.
- I. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- J. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- K. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.09. STARTING AND ADJUSTING

- A. As applicable, coordinate startup and adjusting of equipment and operating components with commissioning requirements in Division 01 specification sections.
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Division 01 Section "Quality Requirements."

3.10. PROTECTION OF INSTALLED CONSTRUCTION

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

SECTION 01 7419 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 – GENERAL

1.01. SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Salvaging and/or recycling nonhazardous demolition and construction waste.
 - 2. Disposing of nonhazardous construction waste.

1.02. DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- C. Salvage / Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

1.03. PERFORMANCE REQUIREMENTS

A. General: Achieve end-of-Project rates for salvage/recycling of 50 percent by weight of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials.

1.04. SUBMITTALS

- A. Waste Management Plan: Submit plan within 30 days of date established for commencement of the Work.
- B. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Include the following information:
 - 1. Material category.
 - 2. Generation point of waste.
 - 3. Total quantity of waste in tons (tonnes).
 - 4. Total quantity of waste recovered (salvaged plus recycled) in tons (tonnes).
 - Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- C. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- D. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- E. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- F. Submittal: Letter signed by Contractor, tabulating total waste material, quantities diverted and means by which it is diverted, and statement that requirements have been met.

1.05. QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:

- 1. Review and discuss waste management plan.
- 2. Review requirements for documenting quantities of each type of waste and its disposition.
- 3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
- 4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
- 5. Review waste management requirements for each trade.

1.06. WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to ASTM E 1609 and requirements of this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of site-clearing and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
 - 1. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
 - 2. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
 - 3. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.
- D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Include the following:
 - Total quantity of waste.
 - 2. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
 - 3. Total cost of disposal (with no waste management).
 - 4. Revenue from salvaged / recycled materials.
 - 5. Savings in hauling and tipping fees that are avoided.
 - Handling and transportation costs. Include cost of collection containers for each type of waste
 - 7. Net additional cost or net savings from waste management plan.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.07. PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
 - 1. Comply with Division 01 Section "Temporary Facilities and Controls" for operation, termination, and removal requirements.
- B. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

- 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
- 2. Comply with Division 01 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.08. RECYCLING CONSTRUCTION WASTE

A. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

3.09. DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 - Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate onsite.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Disposal: Transport waste materials off Owner's property and legally dispose of them.

SECTION 01 7700 CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01. SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.
 - 6. Attic stock provisions.

1.02. SUBMITTALS

- A. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- B. Certified List of Incomplete Items: Final submittal at Final Completion.
- C. Certificates of Release: From authorities having jurisdiction.
- D. Certificate of Insurance: For continuing coverage.
- E. Field Report: For pest control inspection.
- F. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.03. SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
 - 3. Submit closeout submittals specified in individual Divisions 02 through 33 Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Submit maintenance material submittals specified in individual Divisions 02 through 33 Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Owner's signature for receipt of submittals.
 - 5. Submit test/adjust/balance records.
- C. Procedures Prior to Substantial Completion: Complete the following prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Advise Owner of pending insurance changeover requirements.

- Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's
 personnel of changeover in security provisions.
- 3. Complete startup and testing of systems and equipment.
- 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
- 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Division 01 Section "Demonstration and Training."
- 6. Advise Owner of changeover in heat and other utilities.
- 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
- 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
- 9. Complete final cleaning requirements, including touchup painting.
- Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
 - 1. Reinspection: Request, in writing, reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 - 2. Results of completed inspection will form the basis of requirements for final completion.
- E. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

1.04. FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
 - 1. Submit a final Application for Payment according to Division 01 Section "Payment
 - a. Procedures."
 - b. If applicable, the final change order must be executed and included in the final application for payment before final completion can be achieved
 - Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list). Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 - 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 - 4. Submit pest-control final inspection report.
- B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
 - 1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.05. LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction

- Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
- 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
- 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.
- Submit list of incomplete items in the format agreed upon by the Owner and Architect.

1.06. SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within minimum number days, as required by the Contract, of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
 - Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 PRODUCTS

2.01. MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
 - 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 EXECUTION

3.01. FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations, as applicable, before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.

- Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
- Remove tools, construction equipment, machinery, and surplus material from Project site.
- e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
- f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
- g. Sweep concrete floors broom clean in unoccupied spaces.
- h. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
- Clean transparent materials, including mirrors and glass in doors and windows.
 Remove glazing compounds and other noticeable, vision-obscuring materials.
 Polish mirrors and glass, taking care not to scratch surfaces.
- j. Remove labels that are not permanent.
- k. Remove all graffiti and construction writing.
- Wipe surfaces of mechanical and electrical equipment and similar equipment.
 Remove excess lubrication, paint and mortar droppings, and other foreign substances.
- m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
- n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
- Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
- p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
- q. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Division 01 Section "Temporary Facilities and Controls." Prepare written report.
- D. Construction Waste Disposal: Comply with waste disposal requirements in Division 01 Section "Temporary Facilities and Controls." and Division 01 Section "Construction Waste Management and Disposal", whichever is the more restrictive and as follows:
 - Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

3.02. REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
 - 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
 - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.

- a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
- 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
- 4. Replace all lamps and starters to comply with requirements for new fixtures.
- C. All Warranties remain in effect.

3.03. ATTIC STOCK PROVISIONS

- A. Where applicable, the following quantities of attic stock shall be provided:
 - 1. Carpet: 50 LF per 600 SF
 - 2. Carpet base: 200 LF
 - 3. Floor & wall tile: (restroom) 2 boxes
 - 4. Resilient Flooring: 2 boxes
 - 5. Sheet Vinyl: 250 SF
 - 6. Rubber base: 1 box/110 LF
 - 7. Paint: Interior colors and Exterior colors, 6-8 gallons each
 - 8. Ceiling tile: 2 types: 4-5 cartons each

SECTION 01 7823 OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.01. SUMMARY

- A. 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. Product maintenance manuals.
 - 5. Systems and equipment maintenance manuals.

1.02. DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.03. CLOSEOUT SUBMITTALS

- A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
- B. Format: Submit operations and maintenance manuals in the following format:
 - 1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Owner.
 - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are approved.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and before commencing demonstration and training. Architect will return copy with comments.
 - 1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.01. OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
 - List of documents.
 - 2. List of systems.
 - 3. List of equipment.
 - 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.
- 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."

2.02. REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- 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.
 - Manual contents.
- B. Title Page: Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of Project.
 - 3. Name and address of Owner.
 - 4. Date of submittal.
 - 5. Name and contact information for Contractor.
 - 6. Name and contact information for Architect.
 - 7. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 - 8. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
 - 1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 - Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 - 2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

2.03. 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.
- Flood.
- 3. Gas leak.
- Water leak.
- 5. Power failure.
- 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.

2.04. 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. Use designations for systems and equipment indicated on Contract Documents.
 - 2. Performance and design criteria if Contractor has delegated design responsibility.
 - 3. Operating standards.
 - 4. Operating procedures.
 - 5. Operating logs.
 - 6. Wiring diagrams.
 - 7. Control diagrams.
 - 8. Piped system diagrams.
 - 9. Precautions against improper use.
 - 10. License requirements including inspection and renewal dates.
- B. B. Descriptions: Include the following:
 - Product name and model number. Use designations for products indicated on Contract Documents.
 - 2. Manufacturer's name.
 - 3. Equipment identification with serial number of each component.
 - 4. Equipment function.
 - Operating characteristics.
 - 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:
 - 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.
- 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.

2.05. PRODUCT MAINTENANCE MANUALS

- 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 and drawing or schedule designation or identifier where applicable.
- C. Product Information: Include the following, as applicable:
 - Product name and model number.
 - 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.
 - 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.
 - 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.

2.06. SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- 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 and drawing or schedule designation or identifier where applicable.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
 - 1. Standard 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.
 - Troubleshooting guide.
 - 3. Precautions against improper maintenance.
 - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - 5. Aligning, adjusting, and checking instructions.
 - 6. Demonstration and training video recording, if available.
- 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. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.01. 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.
- D. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 - 1. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- E. 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.
- F. 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 01 Section "Project Record Documents."
- G. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

SECTION 01 7839 PROJECT RECORD DOCUMENTS

PART 1- GENERAL

1.01. SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.

1.02. SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit copies of record Drawings as follows:
 - a. Initial Submittal:
- B. Submit PDF electronic files of scanned record.
- C. Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are approved.
 - 1. Final Submittal:
- D. Submit PDF electronic files of scanned record.
- E. Submit a complete copy of the form provided at the end of this section.
- F. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- G. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.
- H. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

PART 2 - PRODUCTS

2.01. ELECTRONIC PROJECT MANAGEMENT SOFTWARE

A. Electronic File of Project Record Documents: Provide Architect with an independent electronic archive of accepted project record documents using electronic project management software as defined in Division 01 Section "Project Management and Coordination", in addition to the printed documents described elsewhere in this Section.

2.02. RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an approved drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding archive photographic documentation.
 - 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.

- c. Depths of foundations 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 by Change Order or Construction Change Directive.
- k. Changes made following Architect's written orders.
- I. Details not on the original Contract Drawings.
- m. Field records for variable and concealed conditions.
- n. Record information on the Work that is shown only schematically.
- Mark the Contract Drawings and Shop Drawings completely and accurately. Use
 personnel proficient at recording graphic information in production of marked-up record
 prints.
- 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
- 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.

2.03. RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 - 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 - 4. Note related Change Orders, record Product Data, and record Drawings where applicable.
- B. Format: Submit record Specifications as scanned PDF electronic file(s) of marked-up paper copy of Specifications.

2.04. RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 - 3. Note related Change Orders, record Specifications, and record Drawings where applicable.
- B. Format: Submit record Product Data as scanned PDF electronic file(s) of marked-up paper copy of Product Data.
 - 1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

2.05. MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as scanned PDF electronic file(s) of marked-up miscellaneous record submittals.
 - 1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.01. RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. 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.

SECTION 01 7900 DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.01. SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.

1.02. SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products.
- B. Qualification Data: For instructor.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.03. QUALITY ASSURANCE

- A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.
- B. Pre-instruction Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
 - 1. Inspect and discuss locations and other facilities required for instruction.
 - 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
 - 3. Review required content of instruction.
 - 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.04. COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.01. INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.

- b. Performance and design criteria if Contractor is delegated design responsibility.
- c. Operating standards.
- d. Regulatory requirements.
- e. Equipment function.
- f. Operating characteristics.
- g. Limiting conditions.
- h. Performance curves.
- C. Documentation: Review the following items in detail:
 - 1. Emergency manuals.
 - 2. Operations manuals.
 - 3. Maintenance manuals.
 - 4. Project record documents.
 - Identification systems.
 - 6. Warranties and bonds.
 - 7. Maintenance service agreements and similar continuing commitments.
 - 8. Emergencies: Include the following, as applicable:
 - Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
 - 9. Operations: Include the following, as applicable:
 - Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - I. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
 - 10. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
 - 11. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
 - 12. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.

- d. Procedures for routine cleaning
- e. Procedures for preventive maintenance.
- f. Procedures for routine maintenance.
- g. Instruction on use of special tools.
- 13. Repairs: Include the following: a. Diagnosis instructions.
 - a. Repair instructions.
 - Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - c. Instructions for identifying parts and components.
 - d. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.01. PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Division 01 Section "Operations and Maintenance Data."
- B. Set up instructional equipment at instruction location.

3.02. INSTRUCTION

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Owner will furnish Contractor with names and positions of participants.
- B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - Schedule training with Owner with at least seven days' advance notice.
- C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- D. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.
- E. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

SECTION 02 4100 DEMOLITION

PART 1 - GENERAL

1.01. SECTION INCLUDES

- A. Building demolition excluding removal of hazardous materials and toxic substances.
- B. Selective demolition of built site elements.
- C. Selective demolition of building elements for alteration purposes.

1.02. RELATED REQUIREMENTS

- A. Section 00 3100 Available Project Information: Existing building survey conducted by Owner; information about known hazardous materials.
- B. Section 01 1000 Summary: Limitations on Contractor's use of site and premises.
- C. Section 01 1000 Summary: Sequencing and staging requirements.
- D. Section 01 1000 Summary: Description of items to be salvaged or removed for re-use by Contractor.
- E. Section 01 5000 Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- F. Section 01 6000 Product Requirements: Handling and storage of items removed for salvage and relocation.
- G. Section 01 7000 Execution and Closeout Requirements: Project conditions; protection of benchmarks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.
- H. Section 01 7419 Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.
- I. Section 31 2323 Fill: Fill material for filling holes, pits, and excavations generated as a result of removal operations.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01. SCOPE

- A. Remove portions of existing buildings in the following sequence:
 - 1. As indicated on drawings.
- B. Remove concrete slabs on grade within site boundaries.
- C. Remove other items indicated, for salvage, relocation, and recycling.
- D. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as specified in Section 31 2200.

3.02. GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.
 - 2. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 - 3. Provide, erect, and maintain temporary barriers and security devices.
 - 4. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
 - Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 - 6. Do not close or obstruct roadways or sidewalks without permit.
 - 7. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.

- 8. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
- B. Do not begin removal until receipt of notification to proceed from Owner.
- C. Do not begin removal until built elements to be salvaged or relocated have been removed.
- D. Do not begin removal until vegetation to be relocated has been removed and specified measures have been taken to protect vegetation to remain.
- E. Protect existing structures and other elements that are not to be removed.
 - 1. Provide bracing and shoring.
 - 2. Prevent movement or settlement of adjacent structures.
 - 3. Stop work immediately if adjacent structures appear to be in danger.
- F. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- G. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.
- H. Perform demolition in a manner that maximizes salvage and recycling of materials.
 - 1. Comply with requirements of Section 01 7419 Waste Management.
 - 2. Dismantle existing construction and separate materials.

3.03. EXISTING UTILITIES

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

3.04. SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 - 1. Verify that construction and utility arrangements are as indicated.
 - 2. Report discrepancies to Architect before disturbing existing installation.
 - 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Separate areas in which demolition is being conducted from other areas that are still occupied.
 - 1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 5000 in locations indicated on drawings.
 - 2. Provide sound retardant partitions of construction indicated on drawings in locations indicated on drawings.
- C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
- D. Remove existing work as indicated and as required to accomplish new work.
 - 1. Remove items indicated on drawings.

- E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
 - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
 - 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - 3. See Section 01 1000 for other limitations on outages and required notifications.
 - 4. Verify that abandoned services serve only abandoned facilities before removal.
 - 5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
- F. Protect existing work to remain.
 - 1. Prevent movement of structure; provide shoring and bracing if necessary.
 - 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 - 3. Repair adjacent construction and finishes damaged during removal work.
 - 4. Patch as specified for patching new work.

3.05. DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.
- B. Remove from site all materials not to be reused on site; comply with requirements of Section 01 7419 Waste Management.
- C. Leave site in clean condition, ready for subsequent work.
- D. Clean up spillage and wind-blown debris from public and private lands.

SECTION 06 4023 INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.01. RELATED DOCUMENTS

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

1.02. SUMMARY

- A. This Section includes the following:
 - 1. Plastic laminate cabinets.
 - 2. Solid-surfacing countertops.

Note: All solid surface and plastic laminate countertops to have 3/4" backer boards

- B. 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 "Stile and Rail Wood Doors."

1.03. DEFINITIONS

A. Interior architectural woodwork includes wood furring, blocking, shims, hanging strips and cleats for installing woodwork items, unless concealed within other construction before woodwork installation.

1.04. SUBMITTALS

- A. Product Data: For each type of product indicated, including cabinet hardware and accessories, and finishing materials and processes.
- B. Product Data: For hardboard, medium-density fiberboard, particleboard, plywood, high-pressure decorative laminate, metal laminate, adhesive for bonding, thermoset shelving decorative overlay, solid-surfacing material, fire-retardant-treated materials, stone materials, cabinet hardware and accessories, and finishing materials and processes.
 - 1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.
- C. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
 - 1. Show details full size.
 - 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 - 3. Show location and sizes of cutouts and holes for items installed in woodwork.
 - 4. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.
 - 5. Apply AWI-certified compliance label to first page of Shop Drawings.
- D. Samples for Initial Selection:
 - 1. Plastic laminates.
 - 2. PVC edge material.
 - 3. Solid-surfacing materials.
- E. Samples for Verification: For the following:
 - Plastic-laminate-clad panel products, 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish, with separate samples of unfaced panel product used for core.
 - 2. Thermoset decorative-overlay surfaced panel products, 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish.
 - 3. Solid-surfacing materials, 6 inches (150 mm) square.
 - 4. Engineering resin panels, 8 by 10 inches (200 by 250 mm).
 - 5. Dimensional wall panels, 8 by 10 inches (200 by 250 mm).

- 6. Corner pieces as follows:
 - a. Cabinet front frame joints between stiles and rail as well as exposed end pieces, 12 inches high by 12 inches wide by 6 inches deep.
 - b. Miter joints for standing trim
- 7. Miter joints for standing trim.
- 8. Exposed cabinet hardware and accessories, one unit for each type and finish.
- F. Product Certificates: Numbered by AWI and signed by AWI inspectors that the products and finished work comply with requirements of the specifications.
- G. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.
- H. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.05. QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing architectural woodwork similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required work.
- B. Installer Qualifications:
 - 1. 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.
 - 2. Certified participant in AWI's Quality Certification Program.
- C. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production and installation of interior architectural woodwork with sequence match wood veneers.
- D. Quality Standard: Unless otherwise indicated, comply with the 2015 NAAWS/AWI / AWMAC / WI "Architectural Woodwork Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
 - Installer to provide letter of certification that cabinets are built to required AWI standards.
- E. Fire-Test-Response Characteristics: Where fire-retardant materials or products are indicated, provide materials and products with specified fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.
- F. Composite wood, agrifiber products, and adhesives shall not contain urea-formaldehyde resin.
- G. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockups of typical standing and running trim, flush wood paneling, architectural wood cabinets, and shop-applied transparent finish, as shown on Drawings, or if not shown, as directed by Architect.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."
- 1.06. DELIVERY, STORAGE, AND HANDLING
 - A. Do not deliver woodwork until wet work, 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.

1.07. 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 between 25 and 55 percent during the remainder of the construction and installation 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. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed and indicate measurements on Shop Drawings.
 - 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish "hold to" 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.

1.08. 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

2.01. MATERIALS

- A. General: Provide materials that comply with requirements of 2014 NAAWS Architectural Woodwork Standards quality standard for each type of woodwork and quality grade specified, unless otherwise indicated
- B. Wood Products: Comply with the following:
 - 1. Recycled Content of Medium-Density Fiberboard and Particleboard: Provide products with an average recycled content so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
 - 2. Hardboard: AHA A135.4.
 - 3. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no added urea formaldehyde.
 - 4. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
 - 5. Softwood Plywood: DOC PS 1, Medium Density Overlay.
- C. 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-1.
 - 1. Provide PVC or polyester edge banding complying with LMA EDG-1 on components with exposed or semi-exposed edges
- D. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated, or if not indicated, as required by woodwork quality standard.
 - 1. Some laminates will require custom colors and graphics. Architect will provide electronic file of custom graphics after award of contract.
- E. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with material and performance requirements in ANSI Z124.3, for Type 5 or Type 6, without a precoated finish.

2.02. FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this Article, that are acceptable to authorities having jurisdiction, and with firetest-response characteristics specified.
 - 1. Do not use treated materials that do not comply with requirements of referenced woodworking standard or that are warped, discolored, or otherwise defective.

- 2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
- 3. Identify fire-retardant-treated materials with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Comply with performance requirements of AWPA C20 (lumber) and AWPA C27 (plywood). Use the following treatment type:
 - 1. Interior Type A: Low-hygroscopic formulation.
 - Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.
 - 3. Kiln-dry materials before and after treatment to levels required for untreated materials.
- C. Fire-Retardant Fiberboard: Medium-density fiberboard panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smokedeveloped index of 200 or less per ASTM E 84.
 - 1. Product: Subject to compliance with requirements, provide "Medite FR" by SierraPine Ltd.; Medite Div.

2.03. CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Division 8 Section "Door Hardware."
- 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. Back-Mounted Pulls: BHMA A156.9, B02011.
- E. Adjustable Shelf Standards and Supports: Hafele 5 mm diameter metal shelf rests for 32 mm boring system or equal.
- F. Shelf Rests: BHMA A156.9, B04013.
- G. Drawer Slides: Side-mounted, full-extension, zinc-plated steel drawer slides with steel ball bearings, manufactured by Accuride or equal, and rated for the following loads:
 - 1. Box Drawer Slides: 100 lbf (440 N).
- H. Door Locks: BHMA A156.11, E07121. provide for all doors unless otherwise shown.
- I. Drawer Locks: BHMA A156.11, E07041. provide for all drawers unless otherwise shown.
- J. Grommets for Cable Passage through Countertops: 2-inch (51-mm)OD, Metal US10 bronze finish with matching caps with slot for wire passage.
 - 1. Product: Subject to compliance with requirements, by Doug Mockett and Co., Inc.
- K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 - 1. As noted in Section 090000 "Finish Legend".
- For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.04. MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide 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.

C. Interlocking wall cleat system for installation of wall paneling and wainscot. Solid wood wall cleat. (French cleat)

2.05. FABRICATION, GENERAL

- A. Interior Woodwork Grade: Premium.
- 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
- Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- D. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
 - 1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members and Rails: 1/16 inch (1.5 mm).
- E. 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.
 - 1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
 - Trial fit assemblies at fabrication shop that cannot be shipped completely assembled.
 Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.
- F. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
- G. Seal edges of openings in countertops with two coats of waterproof sealer.

2.06. PLASTIC-LAMINATE CABINETS

- A. Quality Standard: Comply with Section 10, 2014 NAAWS STANDARDS requirements for laminate cabinets.
- B. AWI Type of Cabinet Construction: Flush overlay with all cabinet bodies ¾ inch thick minimum and all shelves minimum 1-½ inches thick for all spans.
- C. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
 - 1. Horizontal Surfaces Other Than Tops: HGS.
 - 2. Postformed Surfaces: HGP.
 - 3. Vertical Surfaces: HGS.
 - 4. Edges: PVC Edging full depth of edge. Color to match laminate as selected by Architect.
- D. Materials for Semi-exposed Surfaces: Provide surface materials indicated below:
 - 1. Surfaces Other Than Drawer Bodies: Thermoset decorative overlay.
 - 2. Drawer Sides and Backs: Thermoset decorative overlay.
 - 3. Drawer Bottoms: Thermoset decorative overlay.
- E. Colors, Patterns, and Finishes: As indicated in Section 090000 "Finish Legend".
- F. Provide dust panels of 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

2.07. SOLID-SURFACING-MATERIAL COUNTERTOPS

- A. Quality Standard: Comply with AWI Section 11 of 2014 NAAWS STANDARDS requirements for countertops.
- B. Colors, Patterns, and Finishes: As indicated in Section 090000 "Finish Legend".

- C. Fabricate tops in one piece with shop-applied edges, unless otherwise indicated. Comply with solid-surfacing-material manufacturer's written recommendations for adhesives, sealers, fabrication, and finishing.
- D. Configuration: Provide countertops with the following front and backsplash style:
 - 1. Front: Straight, slightly eased at top.
 - 2. Backsplash: Straight, slightly eased at corner.
 - 3. Endsplash: Matching backsplash.
- E. Countertops: 1/2-inch- (12.7-mm-) thick, solid surface material with front edge built up with same material.
- F. Backsplashes: 3/4-inch- (19-mm-) thick, solid surface material.
- G. Fabrication: Fabricate tops in one piece with shop-applied edges unless otherwise indicated. Comply with solid-surface-material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
 - 1. Fabricate with loose backsplashes for field assembly.
- H. Drill holes in countertops for plumbing fittings and soap dispensers in shop.

PART 3 - EXECUTION

3.01. PREPARATION

- A. Stabilize and maintain temperature within occupancy range, and humidity within 25 and 55% at least one week prior to the date of jobsite arrival for the architectural woodwork.
- B. Condition woodwork to average prevailing humidity conditions in installation areas before installation.
- C. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.02. INSTALLATION

- A. Quality Standard: Install woodwork to comply with the 2009 Architectural Woodwork Standards for the same grade specified in Part 2 of this Section for type of woodwork involved.
- B. Grade: Premium.
- C. 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 (3 mm in 2400 mm).
- D. Scribe and cut woodwork to fit adjoining work, and refinish cut surfaces and repair damaged finish at cuts.
- E. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.
- F. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- G. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 1. Install cabinets with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
 - 2. Maintain veneer sequence matching of wood cabinets with transparent finish, from cabinet to cabinet.
 - 3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches (400 mm) o.c. with No. 10 wafer-head screws sized for 1-inch (25-mm) penetration into wood or metal framing, blocking, or hanging strips.
- H. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

- 1. Align adjacent surfaces and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- 2. Install countertops with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
- 3. Secure backsplashes and endsplashes to tops with concealed metal brackets at 16 inches (400 mm) o.c. and to walls with adhesive. Comply with manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
- 4. Seal edges of cutouts in particleboard subtops by saturating with varnish.
- 5. Calk space between backsplash and wall with sealant specified in Division 7 Section "Joint Sealants."

3.03. 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.

SECTION 06 4100 ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

- 1.01. SECTION INCLUDES
 - A. Specially fabricated cabinet units.
 - B. Countertops.
 - C. Solid surface sinks and accessory shelves
 - D. Hardware.
- 1.02. RELATED REQUIREMENTS
 - A. Section 01 6116 Volatile Organic Compound (VOC) Content Restrictions.
- 1.03. REFERENCE STANDARDS
 - A. AWI/AWMAC/WI (AWS) Architectural Woodwork Standards; 2014.
 - B. AWMAC/WI (NAAWS) North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.
 - C. BHMA A156.9 American National Standard for Cabinet Hardware; 2015.
 - D. NEMA LD 3 High-Pressure Decorative Laminates; 2005.
- 1.04. SUBMITTALS
 - A. See Section 01 3000 Administrative Requirements, for submittal procedures.
 - B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.
 - 2. Drawings Required: Plans, elevations and detailed sections of all cabinets.
 - 3. Provide the information required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
 - Do not reproduce Architect's Drawings.
 - C. Product Data: Provide data for hardware accessories.
 - D. Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches square, illustrating proposed cabinet, countertop, and shelf unit substrate and finish.
- 1.05. QUALITY ASSURANCE
 - A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
- 1.06. DELIVERY, STORAGE, AND HANDLING
 - A. Protect units from moisture damage.
- 1.07. 1.07 FIELD CONDITIONS
 - A. A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

- 2.01. CABINETS
 - A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
 - 1. Cabinet Style: Flush overlay.
 - 2. Cabinet Doors and Drawer Fronts: Flush style.
 - 3. Drawer Side Construction: Multiple-dovetailed.
 - a. Hardwood plywood all sides and bottom.
- 2.02. WOOD-BASED COMPONENTS
 - A. Wood fabricated from old growth timber is not permitted.
- 2.03. LAMINATE MATERIALS
 - A. Plastic Laminate Product:
 - Wilsonart

- a. Color: 8213K-28 Phantom Cocoa
- b. Finish: Gloss Line
- 2. Substitutions: No substitutions.
- B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.
- C. Provide specific types as indicated.
 - 1. Vertical Surfaces: VGS, 0.028 inch nominal thickness.
 - 2. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

2.04. SOLID SURFACE MATERIAL

- A. Manufacturers:
 - Corian: www.corian.com
 - a. Color: White Jasmine
 - 2. HI-MACS; www.lghausysusa.com
 - a. Color: Moondust G160
- B. Countertops
 - Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with material and performance requirements in ANSI Z124.3, for Type 5 or Type 6, without a precoated finish.
 - a. Counter Perimeter Backsplash: 3/4"
- C. Integral Sinks
 - 1. Countertop of solid polymer material complete with integrally molded bowl of solid polymer material.
- D. Recessed Accessory Shelves:
 - 1. Body: 1/2" thick solid surfacing, adhesively joined with inconspicuous seams
 - 2. Horizontal shelf: 3/4" thick solid surfacing.

2.05. ACCESSORIES

- A. Adhesive: Type recommended by fabricator to suit application.
- B. Plastic Edge Banding: Extruded PVC, convex shaped; smooth finish; self-locking serrated tongue; of width to match component thickness.
 - 1. Color: As selected by Architect from manufacturer's standard range.
 - 2. Thickness: 3 mm.
 - 3. Use at all exposed plywood edges.
 - 4. Use at all exposed shelf edges.
- C. Fasteners: Size and type to suit application.
- D. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
- E. Concealed Joint Fasteners: Threaded steel.
- F. Grommets: Standard plastic, painted metal, or rubber grommets for cut-outs, in color to match adjacent surface.

2.06. HARDWARE

- A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.
- B. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards or multiple holes for pin supports and coordinated self-rests, polished chrome finish, for nominal 1 inch spacing adjustments.
- C. Drawer and Door Pulls: "U" shaped wire pull, steel with chrome finish, 4 inch centers.
- D. Drawer Slides:
 - 1. Type: Full extension.

- 2. Static Load Capacity: Heavy Duty grade.
- 3. Mounting: Side mounted.
- 4. Stops: Integral type.
- E. Hinges: European style concealed self-closing type, steel with nickel-plated finish.

2.07. FABRICATION

- A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises.
- E. Solid Surface Components: Form joint seams between solid surfacing components with specified seam adhesive. Completed joints inconspicuous in appearance and without voids. Provide joint reinforced if required by manufacturer for particular installation conditions. Provide holes and cutouts indicated on approved shop drawings. Rout cutouts and complete by sanding all edges smooth

PART 3 EXECUTION

3.01. EXAMINATION

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

3.02. INSTALLATION

- A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.
- B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- C. Use fixture attachments in concealed locations for wall mounted components.
- D. Use concealed joint fasteners to align and secure adjoining cabinet units.
- E. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
- F. Secure cabinets to floor using appropriate angles and anchorages.
- G. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

3.03. ADJUSTING

A. Adjust moving or operating parts to function smoothly and correctly.

3.04. CLEANING

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

SECTION 07 8400 FIRESTOPPING

PART 1 GENERAL

- 1.01. RELATED DOCUMENTS
 - Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Section, apply to work specified in this section.
- 1.02. **DEFINITIONS**
 - A. Firestopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in, or construction joints between, fire rated wall and floor assemblies.
- GENERAL DESCRIPTION OF THE WORK OF THIS SECTION 1.03.

Only tested firestop systems shall be used in specific locations as follows:

- A. Penetrations for the passage of duct, cable, cable tray, conduit, piping, electrical busways and raceways through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.
- B. Safing slot gaps between edge of floor slabs and curtain walls.
- C. Openings between structurally separate sections of wall or floors.
- D. Gaps between the top of walls and ceilings or roof assemblies.
- E. Expansion joints in walls and floors.
- Openings and penetrations in fire-rated partitions or walls containing fire doors.
- G. Openings around structural members which penetrate floors or walls.
- RELATED WORK OF OTHER SECTIONS 1.04.
 - Coordinate work of this section with work of other sections as required to properly execute the work and as necessary to maintain satisfactory progress of the work of other sections, including:
 - 1. Section 03 30 00 Cast-In-Place Concrete
 - 2. Section 04 20 00 Unit Masonry
 - 3. Section 07 90 00 Joint Protection
 - 4. Section 09 20 00 Plaster and Gypsum Board
 - 5. Section 09 29 00 Gypsum Board
 - 6. Section 13 48 00 Sound, Vibration and Seismic Control
 - 7. Section 21 00 00 Fire Suppression
 - 8. Section 22 00 00 Plumbing
 - 9. Section 23 00 00 Heating, Ventilating, and Air Conditioning
 - 10. Section 26 00 00 Electrical

1.05. REFERENCES

- A. Test Requirements: ASTM E 814, "Standard Method of Fire Tests of Through Penetration Fire
- B. Test Requirements: UL 1479, "Fire Tests of Through-Penetration Firestops"
- Test Requirements: UL 2079, "Tests for Fire Resistance of Building Joint Systems"
- Underwriters Laboratories (UL) of Northbrook, IL publishes tested systems in their "FIRE RESISTANCE DIRECTORY" that is updated annually.
 - 1. UL Fire Resistance Directory:
 - a. Firestop Devices (XHJI)
 - Fire Resistance Ratings (BXRH)
 - Through-Penetration Firestop Systems (XHEZ)
 - d. Fill, Voids, or Cavity Material (XHHW)
 - e. Forming Materials (XHKU)
 - Joint Systems (XHBN) f.
 - Perimeter Fire Containment Systems (XHDG)
- 2. Alternate Systems: "Omega Point Laboratories Directory" (updated annually).
- E. Test Requirements: ASTM E 1966, "Standard Test Method for Fire Resistive Joint Systems"
 F. Test Requirements: ASTM E 2307, "Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-story Test Apparatus"

- G. Inspection Requirements: ASTM E 2174, "Standard Practice for On-site Inspection of Installed Fire Stops"
- H. ASTM E 84, "Standard Test Method for Surface Burning Characteristics of Building Materials"
- I. International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments
- J. All major building codes: ICBO, SBCCI, BOCA, IBC.
- K. NFPA 101 Life Safety Code
- L. NFPA 70 National Electric Code

1.06. QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide through-penetration fire stop systems and fire-resistive joint systems that comply with specified requirements of tested systems.
- B. Fire stop System installation must meet requirements of ASTM E 814, UL 1479 or UL 2079 tested assemblies that provide a fire rating equal to that of construction being penetrated.
- C. Proposed fire stop materials and methods shall conform to applicable governing codes having local jurisdiction.
- D. Fire stop Systems do not reestablish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.
- E. For those firestop applications that exist for which no qualified tested system is available through a manufacturer, an engineering judgment derived from similar qualified tested system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment documents must follow requirements set forth by the International Firestop Council.

1.07. SUBMITTALS

- A. Submit Product Data: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of qualified tested firestop systems to be used and manufacturer's installation instructions to comply with Section 1300.
- B. Manufacturer's engineering judgment identification number and document details when no qualified tested system is available for an application. Engineering judgment must include both project name and contractor's name who will install firestop system as described in document.
- C. Submit material safety data sheets provided with product delivered to job-site.

1.08. INSTALLER QUALIFICATIONS

- A. Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install manufacturer's products per specified requirements. A supplier's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.
- B. Installation Responsibility: assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single sole source firestop specialty contractor.
- C. The work is to be installed by a contractor with at least one of the following qualifications:
 - 1. FM 4991 Approved Contractor
 - 2. UL Approved Contractor
 - 3. Hilti Accredited Fire Stop Specialty Contractor
- D. Firm with not less than 3 years experience with fire stop installation.
- E. Successfully completed not less that 3 comparable scale projects using similar systems.

1.09. DELIVERY, STORAGE, AND HANDLING

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

1.10. PROJECT CONDITIONS

- A. Do not use materials that contain flammable solvents.
- B. Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.
- C. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
- D. Weather conditions: Do not proceed with installation of firestop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and product data sheet.
- E. During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

PART 2 PRODUCTS

2.01. FIRESTOPPING, GENERAL

- A. Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.
- B. Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.
- C. Firestopping Materials are either "cast-in-place" (integral with concrete placement) or "post installed." Provide cast-in-place firestop devices prior to concrete placement.

2.02. ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with through penetration firestop systems (XHEZ), joint systems (XHBN), and perimeter firestop systems (XHDG) listed in Volume 2 of the UL Fire Resistance Directory; provide products of the following manufacturers as identified below:
 - 1. Hilti, Inc., Tulsa, Oklahoma 800-879-8000 www.us.hilti.com
 - Substitution requests shall be considered in accordance with contract provisions.

2.03. MATERIALS

- A. Use only firestop products that have been UL 1479, ASTM E 814 or UL 2079 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.
- B. Pre-installed firestop devices for use with noncombustible and combustible pipes (closed and open systems), conduit, and/or cable bundles penetrating concrete floors and/or gypsum walls, the following products are acceptable:
 - 1. Hilti CP 680-P Cast-In Place Firestop Device
 - a. Add Aerator adaptor when used in conjunction with aerator ("sovent") system.
 - 2. Hilti CP 681 Tub Box Kit for use with tub installations.
 - 3. Hilti CP 680-M Cast-In Place Firestop Device for use with noncombustible penetrants.
 - 4. Hilti CP 653 Speed Sleeve for use with cable penetrations.
 - 5. Hilti CFS-DID Firestop Drop-In Device for use with noncombustible and combustible penetrants.
 - 6. Hilti CFS-BL Firestop Block
- C. Sealants, caulking materials, or foams for use with non-combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT), the following products are acceptable:
 - 1. Hilti FS-ONE Intumescent Firestop Sealant
 - 2. Hilti CP 604 Self-leveling Firestop Sealant
 - 3. Hilti CP 620 Fire Foam
 - 4. Hilti CP 606 Flexible Firestop Sealant
 - 5. Hilti CP 601s Elastomeric Firestop Sealant
- D. Sealants or caulking materials for use with sheet metal ducts, the following products are acceptable:
 - 1. Hilti CP 601s Elastomeric Firestop Sealant

- 2. Hilti CP 606 Flexible Firestop Sealant
- 3. Hilti FS-ONE Intumescent Firestop Sealant
- E. Sealants, caulking or spray materials for use with fire-rated construction joints and other gaps, the following products are acceptable:
 - 1. Hilti CFS-SP WB Firestop Joint Spray
 - 2. Hilti CP 601s Elastomeric Firestop Sealant
 - 3. Hilti CP 606 Flexible Firestop Sealant
 - 4. Hilti CP 604 Self-leveling Firestop Sealant
- F. Pre-formed mineral wool designed to fit flutes of metal profile deck and gap between top of wall and metal profile deck; as a backer for spray material.
 - 1. Hilti CP 777 Speed Plugs
 - 2. Hilti CP 767 Speed Strips
- G. Intumescent sealants, caulking materials for use with combustible items (penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe, the following products are acceptable:
 - 1. Hilti FS-ONE Intumescent Firestop Sealant
- H. Foams, intumescent sealants, or caulking materials for use with flexible cable or cable bundles, the following products are acceptable:
 - 1. Hilti FS-ONE Intumescent Firestop Sealant
 - 2. Hilti CP 620 Fire Foam
 - 3. Hilti CP 601s Elastomeric Firestop Sealant
 - 4. Hilti CP 606 Flexible Firestop Sealant
- I. Non-curing, re-penetrable intumescent putty or foam materials for use with flexible cable or cable bundles, the following products are acceptable:
 - 1. Hilti CP 618 Firestop Putty Stick
 - 2. Hilti CFS-PL Firestop Plug
- J. Wall opening protective materials for use with U.L. listed metallic and specified nonmetallic outlet boxes, the following products are acceptable:
 - 1. Hilti CP 617 Firestop Putty Pad
- K. Firestop collar or wrap devices attached to assembly around combustible plastic pipe (closed and open piping systems), the following products are acceptable:
 - 1. Hilti CP 643N Firestop Collar
 - 2. Hilti CP 644 Firestop Collar
 - 3. Hilti CP 648E/648S Wrap Strips
- L. Materials used for large openings and complex penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:
 - 1. Hilti CP 637 Firestop Mortar
 - 2. Hilti CFS-BL Firestop Block
 - 3. Hilti CP 620 Fire Foam
 - 4. Hilti CP 675T Firestop Board
- M. Non curing, re-penetrable materials used for large size/complex penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:
 - 1. Hilti CFS-BL Firestop Block
 - 2. Hilti CP 675T Firestop Board
- N. Sealants or caulking materials used for openings between structurally separate sections of wall and floors, the following products are acceptable:
 - 1. Hilti CFS-SP WB Firestop Joint Spray
 - 2. Hilti CP 601s Elastomeric Firestop Sealant
 - 3. Hilti CP 606 Flexible Firestop Sealant
 - 4. Hilti CP 604 Self-Leveling Firestop Sealant
- O. For blank openings made in fire-rated wall or floor assemblies, where future penetration of pipes, conduits, or cables is expected, the following products are acceptable:
 - 1. Hilti CFS-BL Firestop Block
 - 2. Hilti CFS-PL Firestop Plug

- P. Provide a firestop system with a "F" Rating as determined by UL 1479 or ASTM E814 which is equal to the time rating of construction being penetrated.
- Q. Provide a firestop system with an Assembly Rating as determined by UL 2079 which is equal to the time rating of construction joint assembly.

PART 3 EXECUTION

3.01. PREPARATION

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

3.02. COORDINATION

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

3.03. INSTALLATION

- A. Regulatory Requirements: Install firestop materials in accordance with UL Fire Resistance Directory or Omega Point Laboratories Directory.
- B. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of throughpenetration and construction joint materials.
 - 1. Seal all holes or voids made by penetrations to ensure an air and water resistant seal.
 - 2. Consult with mechanical engineer, project manager, and damper manufacturer prior to installation of UL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
 - 3. Protect materials from damage on surfaces subjected to traffic.

3.04. FIELD QUALITY CONTROL

- A. Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas
- B. Keep areas of work accessible until inspection by applicable code authorities.
- C. Inspection of through-penetration firestopping shall be performed in accordance with ASTM E 2174, "Standard Practice for On-Site Inspection of Installed Fire Stops" or other recognized standard.
- D. Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.
- E. Manufacturer's Field Services: During Installation, provide periodic destructive testing inspections to assure proper installation/application. After installation is complete, submit findings in writing indicating whether or not the installation of the tested system identified was installed correctly.

3.05. ADJUSTING AND CLEANING

- A. Remove equipment, materials and debris, leaving area in undamaged, clean condition.
- B. Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

3.06. LABOR USE TO INSTALL FIRESTOP SYSTEMS

A. To ensure complete harmony on the project site, the installation of each scope of work is to be performed jurisdictionally correct per existing trade agreements.
SCHEDULE

3.07.

Location		Fire Rating
A.	Corridor fire walls	1 hour
B.	Floors	1 hour
C.	Shaft enclosures	1 hour
D.	Occupancy Separation Walls	1 hour
E.	Area Separation Walls	2 hour

SECTION 07 9005 JOINT SEALERS

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Sealants and joint backing.

1.02. REFERENCE STANDARDS

- A. ASTM C834 Standard Specification for Latex Sealants; 2014.
- B. ASTM C920 Standard Specification for Elastomeric Joint Sealants; 2014.
- C. ASTM C1193 Standard Guide for Use of Joint Sealants; 2013.
- D. ASTM D1667 Standard Specification for Flexible Cellular Materials--Poly(Vinyl Chloride) Foam (Closed-Cell); 2005 (Reapproved 2011).
- E. ASTM D2628 Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements; 1991 (Reapproved 2011).
- F. SCAQMD 1168 South Coast Air Quality Management District Rule No.1168; current edition.

1.03. ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with other sections referencing this section.

1.04. SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating sealant chemical characteristics.
- C. Manufacturer's Installation Instructions: Indicate special procedures.

1.05. QUALITY ASSURANCE

- A. Maintain one copy of each referenced document covering installation requirements on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.06. FIELD CONDITIONS

A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.07. WARRANTY

- A. See Section 01 7800 Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories which fail to achieve watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01. MANUFACTURERS

- A. Gunnable and Pourable Sealants:
 - 1. BASF Construction Chemicals-Building Systems: www.buildingsystems.basf.com.
 - 2. Bostik Inc: www.bostik-us.com.
 - 3. Dow Corning Corporation: www.dowcorning.com.
 - 4. Hilti, Inc: www.us.hilti.com.
 - 5. Momentive Performance Materials, Inc (formerly GE Silicones): www.momentive.com.
 - 6. Pecora Corporation: www.pecora.com.
 - 7. Red Devil: www.reddevil.com.
 - 8. Tremco Global Sealants: www.tremcosealants.com.
 - 9. Sherwin-Williams Company: www.sherwin-williams.com.
 - 10. W.R. Meadows, Inc: www.wrmeadows.com.

2.02. SEALANTS

- A. Sealants and Primers General: Provide only products having lower volatile organic compound (VOC) content than required by South Coast Air Quality Management District Rule No.1168.
- B. General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, Type OP, Grade NF single component, paintable.
 - 1. Color: To be selected by Architect from manufacturer's standard range.
 - 2. Applications: Use for:
 - a. Interior wall and ceiling control joints.
 - b. Joints between door and window frames and wall surfaces.
 - c. Other interior joints for which no other type of sealant is indicated.
- C. Bathtub/Tile Sealant: White silicone; ASTM C920, Uses I, M and A; single component, mildew resistant.
 - 1. Applications: Use for:
 - a. Joints between plumbing fixtures and floor and wall surfaces.
 - b. Joints between kitchen and bath countertops and wall surfaces.

2.03. ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Joint Backing: Round foam rod compatible with sealant; ASTM D 1667, closed cell PVC; oversized 30 to 50 percent larger than joint width.
- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.01. EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Verify that joint backing and release tapes are compatible with sealant.

3.02. PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean and prime joints in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Protect elements surrounding the work of this section from damage or disfigurement.

3.03. INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Install bond breaker where joint backing is not used.
- D. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- E. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- F. Tool joints concave.

3.04. CLEANING

A. Clean adjacent soiled surfaces.

3.05. PROTECTION

A. Protect sealants until cured.

SECTION 07 9200 JOINT SEALANTS

PART 1 - GENERAL

1.01. RELATED DOCUMENTS

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

1.02. SUMMARY

- A. This Section includes sealants for the following applications:
 - 1. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
 - a. Perimeter joints between interior wall surfaces and frames of interior doors and borrowed lites.
 - b. All joints created by new construction.
 - c. Other joints as indicated.
- B. Related Sections include the following:
 - 1. Division 9 Section "Gypsum Board Assemblies" for sealing perimeter joints of gypsum board partitions to reduce sound transmission.

1.03. PERFORMANCE REQUIREMENTS

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

1.04. SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each type and color of joint sealant required. Install joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Product Certificates: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.
- E. SWRI Validation Certificate: For each elastomeric sealant specified to be validated by SWRI's Sealant Validation Program.
- F. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- G. Compatibility and Adhesion Test Reports: From sealant manufacturer indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- H. Product Test Reports: From a qualified testing agency indicating sealants comply with requirements, based on comprehensive testing of current product formulations. I.
 Warranties: Special warranties specified in this Section.

1.05. QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.

- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- C. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36month period.
 - Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.
 - 2. Test elastomeric joint sealants according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in peel, and indentation hardness.
 - 3. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

1.06. 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.

1.07. 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 or are below 40 deg F (4.4 deg C).
 - 2. When joint substrates are wet.
- 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.

1.08. WARRANTY

- A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Installer's Warranty: Written warranty, signed by Installer agreeing to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- C. Special Manufacturer's Warranty: Written warranty, signed by elastomeric sealant manufacturer agreeing to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: 20 years from date of Substantial Completion.
- D. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:
 - 1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
 - 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.

4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.01. PRODUCTS AND MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified in the sealant schedules at the end of Part 3.

2.02. MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range for this characteristic.
- C. VOC Content of Interior Sealants: Provide interior sealants and sealant primers that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Sealants: 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.

2.03. 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.
- B. Additional Movement Capability: Where additional movement capability is specified in the Elastomeric Joint-Sealant Schedule, provide products with the capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the specified percentage change in the joint width existing at the time of installation and remain in compliance with other requirements of ASTM C 920 for uses indicated.
- C. Stain-Test-Response Characteristics: Where elastomeric sealants are specified in the Elastomeric Joint-Sealant Schedule to be non-staining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

2.04. SOLVENT-RELEASE JOINT SEALANTS

- A. Acrylic-Based Solvent-Release Joint-Sealant Standard: Comply with ASTM C 1311 for each product of this description indicated in the Solvent-Release Joint-Sealant Schedule at the end of Part 3
- B. Butyl-Rubber-Based Solvent-Release Joint-Sealant Standard: Comply with ASTM C 1085 for each product of this description indicated in the Solvent-Release Joint-Sealant Schedule at the end of Part 3.

2.05. LATEX JOINT SEALANTS

A. Latex Sealant Standard: Comply with ASTM C 834 for each product of this description indicated in the Latex Joint-Sealant Schedule at the end of Part 3.

2.06. 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 non-sag, paintable, non-staining 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.

2.07. JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
 - 1. Type C: Closed-cell material with a surface skin.
 - 2. Type O: Open-cell material.
 - 3. Type B: Bicellular material with a surface skin.
 - 4. Type: Any material indicated above.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.08. MISCELLANEOUS MATERIALS

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

PART 3 - EXECUTION

3.01. EXAMINATION

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

3.02. PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions and the following requirements:
 - 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 oilfree 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.
 - Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
 - a. Metal.
 - b. Glass.
 - c. Glazed surfaces of ceramic tile.

- 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.

3.03. 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.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and 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 Non-sag 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. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
 - a. Use masking tape to protect adjacent surfaces of recessed tooled joints.

3.04. 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.

3.05. 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.

3.06. ELASTOMERIC JOINT-SEALANT SCHEDULE

- A. Single Component low-Modulus Neutral Nonacid-Curing Silicone Sealant: Where joint sealants of this type are indicated, provide products complying with the following:
 - 1. Products: Available products include the following:
 - a. 790; Dow Corning.
 - b. 890; Pecora Corporation.
 - c. Spectrem 1; Tremco.
 - 2. Type and Grade: S (single component) and NS (non-sag).
 - Class: 25.
 - 4. Additional Movement Capability: 50 percent movement in extension and 50 percent movement in compression for a total of 100 percent movement.
 - 5. Use Related to Exposure: NT (nontraffic).
 - 6. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
 - 7. Stain-Test-Response Characteristics: Non-staining to porous substrates per ASTM C 1248.
 - 8. Applications: Control joints.

3.07. LATEX JOINT-SEALANT SCHEDULE

- A. Latex Sealants: Where joint sealants of this type are indicated, provide products complying with the following:
 - 1. Products:
 - a. Pecora Ac-20+
 - b. Schnee Morehead SM 8200
 - c. Sonolac; Sonneborn Building Products Div., ChemRex, Inc.
 - d. Tremflex 834; Tremco.
 - 2. Applications: Interior joints in gypsum board applications.

3.08. ACOUSTICAL JOINT SEALANTS

- A. Acoustical sealant for concealed and exposed joints: Manufacturer's standard non-sag paintable non-staining gun able, synthetic rubber sealant.
 - 1. Products
 - a. Pecora BA-98.
 - b. Tremco, Tremco Acoustical sealant

SECTION 08 1113 HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

- 1.01. SECTION INCLUDES
 - A. Hollow metal frames for wood doors.
- 1.02. RELATED REQUIREMENTS
 - A. Section 08 7100 Door Hardware.
 - B. Section 09 9113 Exterior Painting: Field painting.
- 1.03. REFERENCE STANDARDS
 - A. ANSI/SDI A250.8 Specifications for Standard Steel Doors and Frames (SDI-100); 2014.
 - B. ANSI/SDI A250.10 Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.
 - C. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
 - D. BHMA A156.115 American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2014.
 - E. ITS (DIR) Directory of Listed Products; current edition.
 - F. SDI 117 Manufacturing Tolerances for Standard Steel Doors and Frames; 2013.
 - G. UL 10C Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
 - H. UL 1784 Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04. SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/quidelines.
- C. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
- D. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.

1.05. QUALITY ASSURANCE

A. Maintain at project site copies of reference standards relating to installation of products specified.

PART 2 - PRODUCTS

2.01. MANUFACTURERS

- A. Steel Frames:
 - 1. Curries; an Assa Abloy Group company;
 - Ceco Door Products; an Assa Abloy Group company.
 - 3. Steelcraft; an Ingersoll-Rand company
 - 4. Amweld International, LLC
 - 5. Kewanee Corp
 - 6. Substitutions: Not permitted.

2.02. PERFORMANCE REQUIREMENTS

A. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type;

for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03. HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
 - 1. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
 - 2. Frame Finish: Factory primed and field finished.

2.04. FINISHES

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

2.05. ACCESSORIES

- A. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
 - 1. Color: Black.
- B. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.01. EXAMINATION

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

3.02. PREPARATION

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

3.03. INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. Coordinate frame anchor placement with wall construction.
- C. Install door hardware as specified in Section 08 7100.

3.04. TOLERANCES

- A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.
- B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.05. ADJUSTING

A. Adjust for smooth and balanced door movement.

SECTION 08 1416 FLUSH WOOD DOORS

PART 1 - GENERAL

- 1.01. SECTION INCLUDES
 - A. Flush wood doors; flush configuration; fire rated and non-rated.
- 1.02. RELATED REQUIREMENTS
 - A. Section 08 1113 Hollow Metal Doors and Frames.
 - B. Section 08 7100 Door Hardware.
 - C. Section 09 9300 Staining and Transparent Finishing: Field finishing of doors.
- 1.03. REFERENCE STANDARDS
 - A. AWI/AWMAC/WI (AWS) Architectural Woodwork Standards; 2014.
 - B. AWMAC/WI (NAAWS) North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.
 - C. NFPA 80 Standard for Fire Doors and Other Opening Protectives; 2016.
 - D. UL 10C Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04. SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type, and characteristics.
- C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
 - 1. Include certification program label.
- D. Specimen warranty.
- E. Test Reports: Show compliance with specified requirements for the following:
- F. Manufacturer's Installation Instructions: Indicate special installation instructions.
- G. Warranty, executed in Owner's name.

1.05. QUALITY ASSURANCE

- A. Maintain one copy of the specified door quality standard on site for review during installation and finishing.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.
- C. Installed Fire Rated Door and Transom Panel Assembly: Conform to NFPA 80 for fire rated class as indicated.

1.06. DELIVERY, STORAGE, AND HANDLING

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

1.07. WARRANTY

- A. See Section 01 7800 Closeout Submittals, for additional warranty requirements.
- B. Interior Doors: Provide manufacturer's warranty for the life of the installation.
- C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 - PRODUCTS

2.01. MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - Flush Wood Doors:
 - a. Algoma Hardwoods Inc.
 - b. Eggers Industries; Architectural Door Division.
 - c. Graham Wood Doors; an Assa Abloy Group company.
 - d. Ipik Door Company.
 - e. Marshfield Door Systems, Inc.
 - f. Oshkosh Door Company.
 - g. VT Industries, Inc.

2.02. DOORS AND PANELS

- A. Doors: See drawings for locations and additional requirements.
- B. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- C. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
- D. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
- E. Provide solid core doors at each location.
- F. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.
- G. Wood veneer facing for field transparent finish as indicated on drawings.

2.03. DOOR AND PANEL CORES

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

2.04. DOOR FACINGS

- A. Veneer Facing for Transparent Finish: Match building standard species and grain.
- B. Stiles: Applied wood edges of same species as faces and covering edges of crossbands; crossband edges of face veneers shall not be visible.
- C. Vertical Edges: Same species as face veneer.

2.05. DOOR CONSTRUCTION

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

2.06. FINISHES - WOOD VENEER DOORS

- A. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 Finishing for grade specified and as follows:
 - 1. Transparent:
 - 2. System 2, Lacquer, Precatalyzed.
 - 3. Stain: Match building standard color.
 - 4. Sheen: Satin.
- B. Factory finish doors in accordance with approved sample.

2.07. ACCESSORIES

A. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.

PART 3 - EXECUTION

3.01. EXAMINATION

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

3.02. INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
 - 1. Install fire-rated doors in accordance with NFPA 80 requirements.
 - 2. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- B. Use machine tools to cut or drill for hardware.
- C. Coordinate installation of doors with installation of frames and hardware.
- D. Coordinate installation of glazing.
- E. Install door louvers plumb and level.

3.03. TOLERANCES

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

3.04. ADJUSTING

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

SECTION 08 3616.13 BARN (SLIDING) DOOR

PART 1 - GENERAL

1.01. SUMMARY

A. Sliding Barn Doors - [flush wood] [aluminum with glass] [wood stile and rail with glass], aluminum frames and related hardware.

1.02. RELATED SECTION

A. Section 08 1416 - Flush Wood Door

1.03. SUBMITTALS

- A. Comply with Section 01 33 00 Submittal Procedures
- B. Product Data: Submit manufacturer's product data, including installation instructions.
- C. Shop Drawings: Submit manufacturer's shop drawings, including plans, elevations, sections, and details, indicating dimensions, tolerances, materials, components, hardware, finish, options, and accessories. Shop Drawings to show required blocking by others.
- D. Manufacturer's Certification: Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application.
- E. Warranty Documentation: Submit manufacturer's standard warranty.

1.04. QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of interior aluminum frames and doors.
- B. Source: Obtain sliding aluminum framed doors and hardware from single source.
- C. Manufacturer's Qualifications: Manufacturer regularly engaged for past 5 years in manufacture of sliding doors similar to that specified.

1.05. REFERENCES

- A. ANSI American National Standards Institute
 - 1. ANSI 156.18 Materials and Finishes
 - ANSI A117.1 Specifications for making buildings and facilities usable by physically handicapped people.
- B. BHMA Builders Hardware Manufacturers Association
- C. DHI Door and Hardware Institute
- D. NFPA National Fire Protection Association
 - 1. NFPA 80 Fire Doors and Windows
 - 2. NFPA 101 Life Safety code
 - 3. NFPA 105 Smoke and Draft Control Door Assemblies
 - 4. NFPA 252 Fire Tests of Doors Assemblies
- E. AWS Architectural Woodwork Standards

1.06. PERFORMANCE

- A. Aluminum perimeter frames with integral acoustic seals
- B. Soft self-closing mechanism integrated with top track
- C. Concealed door quide

1.07. DELIVERY: STORAGE AND PROTECTION

- A. Delivery and Acceptance Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Notify manufacturer immediately of any shipping damage.
- C. Storage and Handling Requirements:
 - 1. Store and handle materials in accordance with manufacturer's instructions.

- 2. Keep materials in manufacturer's original, unopened containers and packaging until installation.
- 3. Store materials in clean, dry area indoors.
- 4. Protect materials and finish during storage, handling, and installation to prevent damage.

PART 2 - PRODUCTS

- 2.01. MANUFACTURER
 - A. AD SYSTEMS
- 2.02. INTERIOR SLIDING ALUMINUM-FRAMED DOORS AND PARTITIONS
 - A. Interior Aluminum-Framed Top-Hung Sliding Doors: Model: AD Systems High Performance Sliding Door System by AD Systems.
 - B. Frame Profiles: Extruded aluminum frame "wrap" frame with integral vertical jamb (stile pocket).
 - 1. Finish:
 - Standard: Painted Hardcoat (Kynar) Finish. Meets AAMA 2604 Standard Colors: [Light Sequin 789G048
 - C. Door Leafs. All Doors to be factory machined for hardware including pilot and function holes.
 - 1. 1-3/4" Flush Wood Door: Reference Spec Section 08200 Wood Doors
 - D. Door Components:
 - 1. Single Top Track: AD Systems extruded aluminum track by AD Systems
 - 2. Valances: Extruded aluminum with integral end caps
 - 3. Top Rollers: tandem nylon roller sized to match door weight
 - 4. Concealed Floor Guide: Integral Jamb floor guide by AD Systems
 - 5. Soft-Closer: Soft and self-closing damper mechanism at both sides of door leaf
 - 6. Automatic Door Bottom for improved acoustical performance
 - 7. Handles:
 - a. [AD Systems Standard Ladder Pull: 16" long x 1" diameter. Finish: US32D Satin Stainless Steel]
 - E. Accessories:
 - 1. Door Locks:
 - a. Mortise Latch and Lock Options: Contact AD Systems for assistance
 - 1) Standard [ADA-2 Thumbturn with Indicator & 16-inch Ladder Pull]

PART 3 - EXECUTION

- 3.01. EXAMINATION
 - A. Examine wall openings to receive sliding doors for plumb, level, and square. Note: Finish door operation will be affected by out of tolerance framing.
 - B. Verify dimensions of wall openings.
 - C. Examine surfaces to receive top and bottom guide.
 - Notify Architect of conditions that would adversely affect installation or subsequent use of sliding doors.
 - E. Do not begin installation until unacceptable conditions are corrected.
 - F. Base of door side to be flush or minimal. Rubber Base acceptable.
- 3.02. INSTALLATION
 - A. Install sliding doors in accordance with manufacturer's instructions at locations indicated on the Drawings.
 - B. Install sliding doors plumb, level, square, and in proper alignment.
 - C. Install sliding doors to close against walls without gaps
 - D. Install sliding doors to open and close smoothly.
 - E. Anchor sliding doors securely in place to supports. Required: Fire treated 2 x 6 blocking required full length of track.

3.03. ADJUSTING

- A. Adjust sliding doors for proper operation in accordance with manufacturer's instructions.
- B. Adjust sliding doors to operate smoothly without binding.
- C. Repair minor damages to finish in accordance with manufacturer's instructions and as approved by Architect.

3.04. CLEANING

- A. Clean sliding doors promptly after installation in accordance with manufacturer's instructions.
- B. Do not use harsh cleaning materials or methods that could damage materials or finish.

3.05. PROTECTION

A. Protect installed sliding doors from damage during construction.

END OF SECTION

SECTION 08 7100 DOOR HARDWARE

PART 1 - GENERAL

1.01. RELATED DOCUMENTS

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

1.02. SUMMARY

- A. This Section includes the following:
 - 1. Commercial door hardware for the following:
 - a. Swinging doors.
 - b. Sliding doors.
 - c. Fire-rated swinging doors.
 - d. Other doors to the extent indicated.
 - 2. Hardware for doors specified in other Sections.
 - 3. Electrified door hardware.
- B. Related Sections include the following:
 - 1. Division 08 Section "Hollow Metal Doors and Frames"
 - 2. Division 08 Section "Aluminum-Framed Entrances and Storefronts"
 - 3. Division 08 Section "Flush Wood Doors"
 - 4. Division 08 Section "Overhead Coiling Doors"
 - 5. Division 26 Sections for connections to electrical power system and for low-voltage wiring work.
 - 6. Division 28 Section "Access Control" for access control devices installed at door openings and provided as part of a security access system.
 - 7. Division 28 Section "Intrusion Detection" for detection devices installed at door openings and provided as part of an intrusion detection system.
 - 8. Division 28 Section "Fire Detection and Alarm" for connections to building fire alarm system.
- C. Products furnished, but not installed, under this Section include the following. Coordinating, purchasing, delivering, and scheduling remain requirements of this Section.
 - 1. Thresholds, weather stripping, and cylinders for locks specified in other Sections.

1.03. SUBMITTALS

- A. Product Data: Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Details of electrified door hardware, indicating the following:
 - 1. Wiring Diagrams: Power, signal, and control wiring. Include the following:
 - a. System schematic.
 - b. Point-to-point wiring diagram.
 - c. Riser diagram.
 - d. Elevation of each door.
 - 2. Detail interface between electrified door hardware and fire alarm, access control, security, building control system.
 - Operation Narrative: Describe the operation of doors controlled by electrified door hardware.
- C. Samples for Verification: For exposed door hardware of each type, in specified finish, full size. Tag with full description for coordination with the door hardware sets. Submit Samples before, or concurrent with, submission of the final door hardware sets, if requested.

- 1. Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.
- D. Qualification Data: For Installer.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for locks, latches, and closers as requested.
- F. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.
- G. Warranty: Special warranty specified in this Section.
- H. Door Hardware Sets: Prepared by or under the supervision of Architectural Hardware Consultant, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final door hardware sets with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - 1. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
 - 2. Content: Include the following information:
 - a. Identification number, location, hand, fire rating, and material of each door and frame.
 - b. Type, style, function, size, quantity, and finish of each door hardware item.
 - c. Complete designations of every item required for each door or opening including name and manufacturer.
 - d. Fastenings and other pertinent information.
 - e. Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - f. Explanation of abbreviations, symbols, and codes contained in schedule.
 - g. Mounting locations for door hardware.
 - h. Door and frame sizes and materials.
 - i. Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.
 - Sequence of Operation: Include description of component functions that occur in the following situations: authorized person wants to enter; authorized person wants to exit; unauthorized person wants to enter; unauthorized person wants to exit.
 - j. List of related door devices specified in other Sections for each door and frame.
 - 3. Submittal Sequence: Submit the final door hardware sets at earliest possible date, particularly where approval of the door hardware sets must precede fabrication of other work that is critical in 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 sets.
- I. Keying Schedule: Prepared by or under the supervision of Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.

1.04. QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by lock manufacturer.
 - Installer's responsibilities include supplying and installing door hardware and providing a
 qualified Architectural Hardware Consultant available during the course of the Work to
 consult with Contractor, Architect, and Owner about door hardware and keying.
 - 2. Installer shall have warehousing facilities in Project's vicinity.
 - 3. Scheduling Responsibility: Preparation of door hardware and keying schedules.

- 4. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Architectural Hardware Consultant Qualifications: A person who is currently certified by DHI as an Architectural Hardware Consultant and who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.
- C. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.
 - Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
- D. Fire-Rated Door Assemblies: 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 NFPA 252 and UBC Standard 7-2.
 - 1. Test Pressure: After 5 minutes into the test, neutral pressure level in furnace shall be established at 40 inches (1016 mm) or less above the sill.
- E. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- F. Keying Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." In addition to Owner, Construction Manager, Contractor, and Architect, conference participants shall also include Installer's Architectural Hardware Consultant and Owner's Security Consultant. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:
 - 1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - 2. Preliminary key system schematic diagram.
 - 3. Requirements for key control system.
 - 4. Address for delivery of keys.
- G. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.05. DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification related to the final door hardware sets, and include basic installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver keys to Owner's Representative by registered mail or overnight package service.

1.06. COORDINATION

- A. Coordinate layout and installation of recessed hardware with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 03
- B. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Coordinate with aluminum entrance door supplier for door hardware installation.

D. Electrical System Roughing-in: Coordinate layout and installation of electrified door hardware with connections to power supplies, fire alarm system and detection devices, access control system, security system, and building control system.

1.07. WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of operators and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
- B. Warranty Period: Three (3) years from date of Substantial Completion, except as follows:
 - a. Locksets: Ten (10) years from date of Substantial Completion.
 - b. Electromagnetic Locks: Five (5) years from date of Substantial Completion.
 - c. Exit Devices: Two (2) years from date of Substantial Completion.
 - d. Manual Closers: Ten (10) years from date of Substantial Completion.

1.08. 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 door hardware.
- B. Maintenance Service: Beginning at Substantial Completion, provide six (6) months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door hardware operation. Provide parts and supplies same as those used in the manufacture and installation of original products.

1.09. EXTRA MATERIALS

- A. Furnish full-size units of door hardware described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Door Hardware:
 - a. 3 ea. VD 98L X 626.
 - b. 3 ea. SCH L9080L X 626.
 - c. 3 ea. LCN 4040XP HEDA 689.

PART 2 - PRODUCTS

2.01. MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Products:
 - a. Finish: Shall be US26D, unless otherwise noted.
 - b. Manufacture Standard:
 - 1) Butts: Hager, McKinney, Stanley, Ives*
 - Locksets: Schlage*
 - 3) Closers: LCN*
 - 4) Exit Devices: Von Duprin*
 - 5) Auto Operators: Hunter Automatics*
 - 6) Trim: BBW, Rockwood, Hager, Ives*
 - 7) Weatherstrip: Pemko, Hager, National Guard*
 - 8) Continuous Hinges: HagerRoton, Markar, Ives*

9) Magnetic Door Holders: Rixson, LCN*

10) Rem Mullion: Von Duprin*

2.02. SCHEDULED HARDWARE

- A. Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of finish hardware are indicated in the "Hardware Schedule" at the end of this Section. Products are identified by using hardware designation numbers of the following:
 - 1. Manufacturer's Product Designations: The product designation and name of one manufacturer are listed for each hardware type required for the purpose of establishing minimum requirements. Provide either the product designated or, where more than one manufacturer is specified under the Article "Manufacturers" in Part 2 for each hardware type, the comparable product of one of the other manufacturers that complies with requirements.
 - ANSI/BHMA designations used elsewhere in this Section or in schedules to describe hardware items or to define quality or function are derived from the following standards. Provide products complying with these standards and requirements specified elsewhere in this Section.
 - a. Butts and Hinges: ANSI A156.1.
 - Bored and Preassembled Locks and Latches: ANSI/BHMA A156.2.
 - c. Exit Devices: ANSI A156.3.
 - d. Door Controls Closers: ANSI A156.4.
 - e. Auxiliary Locks and Associated Products: ANSI/BHMA A156.5.
 - f. Architectural Door Trim: ANSI A156.6.
 - g. Template Hinge Dimensions: ANSI A156.7.
 - h. Door Controls Overhead Holders: ANSI A156.8.
 - Mortise Locks and Latches: ANSI A156.13.
 - j. Closer Holder Release Devices: ANSI A156.15.
 - k. Auxiliary Hardware: ANSI A156.16.
 - I. Self-Closing Hinges and Pivots: ANSI A156.17.
 - m. Materials and Finishes: ANSI A156.18.

2.03. MATERIALS AND FABRICATION

- A. Base Metals: Produce hardware units of basic metal and forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness, but in no case of lesser (commercially recognized) quality than specified for applicable hardware units by applicable ANSI/BHMA A156 series standards for each type of hardware item and with ANSI/BHMA A156.18 for finish designations indicated. Do not furnish "optional" materials or forming methods for those indicated, except as otherwise specified.
- B. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware that has been prepared for self-tapping sheet metal screws, except as specifically indicated.
- C. Furnish screws for installation with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of this other work as closely as possible including "prepared for paint" surfaces to receive painted finish.
- D. Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless their use is the only means of reinforcing the work adequately to fasten the hardware securely. Where thru-bolts are used as a means of reinforcing the work, provide sleeves for each thru-bolt or use sex screw fasteners.

2.04. HINGES, GENERAL

A. Quantity: Provide the following, unless otherwise indicated:

- 1. Two Hinges: For doors with heights up to 60 inches.
- 2. Three Hinges: For doors with heights 61 to 90 inches.
- B. Template Requirements: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.
- C. Hinge Weight: As indicated in hardware sets.
- D. Hinge Base Metal: Unless otherwise indicated, provide the following:
 - 1. Exterior Hinges: Stainless steel with stainless-steel pin.
 - 2. Interior Hinges: Steel with steel pin.
 - 3. Hinges for Fire-Rated Assemblies: Steel with steel pin.
- E. Hinge Options: Where indicated in door hardware sets or on Drawings:
 - 1. Safety Stud: Designed for stud in one leaf to engage hole in opposing leaf.
 - 2. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for outswinging doors.
 - 3. Corners: Square.
- F. Fasteners: Comply with the following:
 - 1. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.
 - Wood Screws: For wood doors and frames.
 - 3. Threaded-to-the-Head Wood Screws: For fire-rated wood doors.

2.05. CONTINUOUS HINGES

- A. Hinges shall be a geared continuous hinge utilizing a single gear section for the door leaf and a separate gear section for the frame side of the door. The door leaf and jamb leaf shall fully mortised where scheduled, and full surface where scheduled. Geared hinges are to be certified to ANSI 156.25, Grade 2 and UL 10C tested and approved for 90 minutes.
- B. Hinge shall be a twin self-lubricated nylon bearing type with stainless steel pin. The door leaf and jamb leaf shall fully mortised. Vertical door loads shall be carried on minimum 3/4" bearings through a full 180 degrees. The door leaf and jamb leaf shall have templated screw hole locations for future replacement needs.

2.06. LOCKS, LATCHES, AND BOLTS

- A. Strikes: Provide manufacturer's standard wrought box strike for each latch or lock bolt, with curved lip extended to protect frame, finished to match hardware set, unless otherwise indicated.
- B. Lock Throw: Provide 5/8-inch (16-mm) minimum throw of latch on pairs of doors. Comply with UL requirements for throw of bolts and latch bolts on rated fire openings.
- C. Flush Bolt Heads: Minimum of 1/2-inch- (13-mm-) diameter rods of brass, bronze, or stainless steel with minimum 12-inch- (300-mm-) long rod for doors up to 84 inches (2100 mm) in height. Provide longer rods as necessary for doors exceeding 84 inches (2100 mm) in height.
- D. Mortise Locks: ANSI 156.13, Series 1000, Grade 1, mortise lock for commercial and institutional buildings.
 - 1. Manufacture lock cases from fully wrapped, heavy 12 gage steel with a protected leading edge and screw configuration that limits access to operating parts. Lock components to be manufactured of zinc dichromate plated steel. Latch bolts to have a standard 2 3/4" backset with a full 3/4" throw.
 - 2. Latchbolts to be non-handed, field reversible without opening the lock case. Latchbolts to be 2 piece anti-friction, manufactured from stainless steel. Solid latchbolts and/or plastic anti-friction devices are not acceptable.
 - 3. Deadbolts to be 1 3/4" total length have standard 1" throw with a minimum 3/4" internal engagement when fully retracted. Deadbolts to be constructed of stainless steel, incorporating a security roller pin with a minimum Rc60 rating for surface hardness.

- 4. Lever assembly (external) to be one piece design attached by threaded bushing. Lever assembly (internal) to be attached by screw less shank. Lever attachments by common tools (allen nuts and/or set screws) are not acceptable. Thru bolt lever assemblies through the door for positive interlock. Levers to have independent rotation in both directions.
- 5. Spring cages are to be incorporated into the lever assemblies. Hub blocking plate to be solid, cast stainless steel. Manufacturers utilizing open hub designs are not acceptable.
- 6. Spindles to be independent, designed to "break away" at a maximum of 75psi torque.

 Mounting tabs are to be automatic self-adjusting, vertically and horizontally for door bevel and strike alignment.
- 7. Cylinders to be secured by a cast stainless steel, dual retainer. Manufacturers utilizing screws and/or stamped retainers are not acceptable.

2.07. KEYING REQUIREMENTS

- A. General: Supplier will meet with Owner to finalize keying requirements and obtain final instructions in writing.
- B. Review the keying system with the Owner and provide a master, grandmaster or greatgrandmaster integrated with Owner's existing system. If key pinning charts are required, owner to furnish charts to hardware supplier.
- C. Furnish temporary keyed cores for the construction period, and remove these when directed. The construction cores remain property of the supplier and shall be returned to the supplier when they are removed. Contractor shall install the permanent cores in the presence of the owner's representative.
- D. Permanent Keys: Secured shipment direct from point of origination to Owner's Representative
 - 1. For estimate: 2 keys per change combination, 5 master keys per group, 5 grand-master keys, 3 control keys.

2.08. KEY CONTROL CABINET

- A. BHMA A156.5; 20 gage metal cabinet with baked-enamel finish; containing key-holding hooks, labels, 2 sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 150 percent of the number of locks.
- B. Wall mounted cabinet with hinged-panel door equipped with key-holding panels and pin-tumbler cylinder door lock.

2.09. PUSH/PULL UNITS

A. Exposed Fasteners: Provide manufacturer's standard exposed fasteners for installation, thrubolted.

2.10. CLOSERS

- A. Accessibility Requirements: Where handles, pulls, latches, locks and other operating devices are indicated to comply with accessibility requirements, comply with the U.S. Architectural Transportations Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."
 - 1. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-fire-rated Hinged Doors: 5 lbf applied perpendicular to door.
 - b. Fire Doors: Minimum opening force allowable by Authorities Having Jurisdiction (AHJ).
- B. Door Closers for Means of Egress Doors: Comply with NFPA 101. Door closers shall not require more than 30 lbf to set door in motion and not more than 15lbf to open door to minimum required width.
- C. Cylinder: Shall be of high strength cast iron construction. All door exterior closers shall be tested to ANSI/BHMA A156.4 test requirements by a BHMA certified independent testing laboratory. A written certification showing successful completion of a minimum of 10,000,000 cycles for all exterior door closers must be provided. Cylinder shall have been manufactured and in the marketplace for a minimum of 10 years

- D. Size of Units: Unless otherwise indicated, comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory sized closers, adjustable to meet field conditions and requirements for opening force.
- E. Surface Closers: BHMA A156.4 Grade 1. Provide type of arm required for closer to be located on non-public side of door, unless otherwise indicated.
 - 1. Full rack-and-pinion type cylinder with removable non-ferrous cover and cast iron body. Double heat-treated pinion shaft, single piece forged piston, chrome silicon steel spring.
 - 2. XL cylinder body to have 1½" piston diameter with 3/4" journal double heat treated shaft, (.1421" teeth thickness,) 5/8" full complement bearings, chrome silicon steel spring.
 - 3. Cylinder body to have "FAST" power adjust speed dial to show spring size power.
 - 4. Closers to have forged steel main arm and forearm for REG, EDA and CUSH type arms
 - 5. ISO 2000 certified. Units stamped with date-of-manufacture code.
 - 6. Independent lab-tested 10,000,000 cycles.
 - 7. Thru-bolts at wood doors unless doors are provided with closer blocking. Non-sized, non-handed, and adjustable. Place closer inside building, stairs, and rooms.
 - 8. Plates, brackets and special templating when needed for interface with particular header, door and wall conditions and neighboring hardware.
 - 9. Opening pressure: Exterior doors 8.5 lb., interior doors 5 lb., labeled fire doors 15 lb.
 - 10. Separate adjusting valves for closing speed, latching speed and backcheck, fourth valve for delayed action where scheduled.
 - 11. Extra-duty arms (EDA) at exterior doors scheduled with parallel arm units.
 - 12. Exterior doors do not require seasonal adjustments in temperatures from 120 degrees F to -30 degrees F, furnish data on request.
 - 13. Non-flaming fluid will not fuel door or floor covering fires.
 - 14. Pressure relief values are not allowed.

2.11. DOOR OPERATORS / ADA SPECIAL CLOSERS

- A. Operation: Push button, push plate, switch-activated, manual or field-programmable manual/electric power assisted opening. Comply with ANSI A156.19, UL 325 and UL 1998.
- B. Door Operators and supporting equipment shall carry a manufacturers two (2) year warranty.
- C. Equipment: Completely electromechanical; comply with ANSI A156.19, UL 325, and UL 1998.
 - 1. Control box and motor/gear box: Contained in aluminum housing.
 - Precision-machined gears and bearing seats and all-weather lubricant, mounted on vibration isolators. No exposed gears. Gears: Precision manufactured gears specifically for operators.
 - 3. Enclosure: Extruded header concealing all operating parts except arms and manual control switches.
 - a. Design for surface-applied application
 - b. Design for bottom loading
 - c. 4-1/2" x 5-3/4" aluminum housing
 - d. Gears enclosed in gearbox
 - 4. Motor: 1/12 hp DC permanent magnet motor with shielded ball bearings. Stop motor when door stops or is fully open and when breakaway is operated.
 - 5. Door operating arm: Forged steel, attached at natural pivot point of door.
 - a. Exposed arms: Surface push/pull arm is cast and machined. Factory-painted and finished to match operator enclosure.
 - b. Overhead concealed arms: Offset pivot concealed arm is cast and machined. Center pivot concealed arm is combination of forging and stamping. Provide concealing arm channel.
- D. Door Operator shall have built in the following features:

- 1. Close door against stop after each cycle, and hold against drafts, winds and stack pressure.
- 2. Manual opening force: 14 lb-force (62 N) maximum.
- 3. Closing force: 9 lb-force (26.6 N).
- 4. Factory-set door hold-open voltage.
- 5. Manual "Off/Auto/Hold-Open" switch.
- 6. On board 1 amp (24VAC) power supply for electric strikes and accessories
- 7. Accessory Connection dedicated and clearly labeled connectors
- 8. Power Boost Disable Option –Power Boost shall shut off when activate signal is received and the Power Boost cycle has been initiated
- 9. Auto Reverse Open door will stop and reverse if an object is encountered in the opening cycle.
- "Off/Auto/Hold-Open" switch: Three-position rocker or key type and slide arm for top of door.
- 11. Control circuits for actuators and safeties: Low-voltage, NEC Class II.
- 12. Service conditions: Satisfactory operation between -30 degrees F (-34 degrees C) and 160 degrees F (71 degrees C).
- 13. Power supply required: 115 VAC (15 amp circuit breaker, one per unit).
- 14. Microprocessor control: 115 VAC.
- 15. Surface-Applied Mounting: On surface of door frame/wall, mounted 1" (25.4 mm) above top of door.
- 16. Provide bottom loading header for access to controls and removable components without removal of door or operator.

2.12. EXIT DEVICES/PANIC HARDWARE

- A. General features: BHMA A156.3. Grade 1.
- B. Accessibility Requirements: Where handles, pulls, latches, locks and other operating devices are indicated to comply with accessibility requirements, comply with the U.S. Architectural Transportations Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."
 - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
- C. Exit Devices for Means of Egress Doors: Comply with NFPA 101. Exit devices shall not require more than 15lbf to release the latch. Locks shall not require use of a key, tool of special knowledge for operation.
- D. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to AHJ for panic protection, based on testing according to UL 305.
 - 1. Independent lab-tested 10,000,000 cycles.
 - 2. Push-through touch pad design. No exposed touch bar fasteners, no exposed cavities when operated. Return stroke fluid dampeners and rubber bottoming dampeners, plus antirattle devices.
 - No exposed screws to show through glass doors.
 - 4. Non-handed basic device design with center case interchangeable with all functions, no extra parts required to effect change of function.
- E. Specific features:
 - 1. Non-Fire Rated Devices: As scheduled in hardware sets.
 - 2. Lever Trim: Vandal resistant, forged brass or bronze escutcheon min .130" thickness, match lockset lever design.
 - 3. Fire-Labeled Devices: UL label indicating "Fire Exit Hardware". Vertical rod devices less bottom rod (LBR) unless otherwise scheduled.

- 4. Electrically Operated Devices: Single manufacturer source for electric latch retraction devices, electrically controlled trim, power transfers, power supplies, monitoring switches and controls.
- 5. Furnish all exit devices with deadlocking latchbolts.
- 6. End caps shall be sloped and of heavy-duty metal alloy construction and provide horizontal adjustment to provide flush alignment with device cover plate. When device end cap is installed, no raised edges will protrude. End cap shall be cast metal or forged aluminum and have a minimum thickness of (.250"). Plastic or metal stamping will not be acceptable.
- 7. Provide all shim kits and filler plates to allow flush mounting of exit devices on all types of doors used in this project.
- 8. Removable Mullions: Removable with single turn of building key. Securely reinstalled without need for key.

2.13. TRIM AND STOPS

- A. Kick plates, mop plates, and armor plates, shall be .050 gauge with 32D finish. Kick plates to be 10" high, mop plates to be 5" high. All plates shall be two (2) inches less full width of door.
- B. Push plates, pull plates, door pulls, and miscellaneous door trim shall be shown in the hardware schedule.
- C. Doorstops shall be furnished for all doors to prevent damage to doors or hardware from striking adjacent walls or fixtures. Wall stops are preferred. Floor stops are used only where noted in hardware schedule. Where conditions prohibit the use wall type stops, furnish overhead stops either surface mounted or concealed as noted in hardware sets.

2.14. WEATHERSTRIPPING AND SEALS

A. General: Provide continuous weatherstripping on exterior doors and smoke, light, or sound seals on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.15. THRESHOLDS

A. General: Except as otherwise indicated, provide standard metal threshold unit of type, size, and profile as shown or scheduled.

2.16. ELECTRICAL HARDWARE

- A. Furnish wiring diagrams to electrical contractor for use in installing electrical hardware products.
- B. Electrical contractor to run all wiring and make all final connections for electrified hardware. Hardware supplier shall be responsible to furnish all wiring diagrams to operate electrified hardware. Access control material and electrified hardware to interface at junction boxes.

2.17. HARDWARE FINISHES

- A. Match items to the manufacturer's standard color and texture finish for the latch and locksets (or push-pull units if no latch or lock sets).
- B. Provide finishes that match those established by BHMA or, if none established, match the Architect's sample.
- C. 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.
- D. The designations used in schedules and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18, "Materials and Finishes," including coordination with the traditional U.S. finishes shown by certain manufacturers for their products.

PART 3 - EXECUTION

3.01. EXAMINATION

- A. Examine doors and frames, 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. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02. PREPARATION

- A. Steel Doors and Frames: Comply with DHI A115 Series.
 - 1. Surface-Applied Door Hardware: Drill and tap doors and frames according to ANSI A250.6.
- B. Wood Doors: Comply with DHI A115-W Series.

3.03. INSTALLATION

- A. Pre-installation conference shall be conducted prior to installation of hardware at Project site. Meet with the, Owner, Contractor, installer, and manufacturers representatives. A separate pre-installation conference shall be conducted prior to the installation of electronic security hardware with the electrical contractor Review catalogs, brochures, templates, installation instructions, and the approved hardware schedule. Survey installation procedures and workmanship, with special emphasis on unusual conditions, as to ensure correct technique of installation, and coordination with other work. Notify participants at least ten, 10 working days before conference.
- B. Hardware Installers must have a minimum of five (5) years experience in installation of hardware. Provide verification of installer's qualification to Consultant for approval. All installers to attend review meetings with the hardware distributor.
- C. Install hardware using only manufacturer supplied and approved fasteners in strict adherence with manufacturers published installation instructions.
- D. Install head seal prior to installation of "PA"-parallel arm mounted door closers and push side mounted door stops/holders. Trim, cut and notch thresholds and saddles neatly to minimally fit the profile of the door frame. Install thresholds and saddles in a bed of caulking completely sealing the underside from water and air penetration.
- E. Counter sink through bolt of door pull under push plate during installation.
- F. Mounting Heights: Mount door hardware units at heights indicated, as follows, unless otherwise indicated or required to comply with governing regulations.
 - Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. Custom Steel Doors and Frames:DHI's "Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames."
 - 3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- G. Install each door hardware item to comply with manufacturer's 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 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- H. Boxed Power Supplies: Locate power supplies as indicated. Verify location with Architect.
 - 1. Configuration: Provide one power supply for each door opening.
 - 2. Configuration: Provide the least number of power supplies required to adequately serve doors with electrified door hardware.
- I. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

3.04. 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.

- Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
- 2. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.
- B. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust, including adjusting operating forces, each item of door hardware as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.05. CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.06. DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Division 01 Section "Demonstration and Training."

3.07. DOOR HARDWARE SETS

- A. The following schedule of hardware sets shall be considered a guide and the supplier is cautioned to refer to general conditions, special conditions, and the full requirements of this section. It shall be the hardware supplier's responsibility to furnish all required hardware.
- B. Where items of hardware are not definitely or correctly specified and are required for completion of the Work, a written statement of such omission, error, conflict, or other discrepancy shall be sent to the Architect, prior to date specified for receipt of bids, for clarification by addendum.
- C. Adjustments to the Contract Sum will not be allowed for omissions or items of hardware not clarified prior to bid opening.

END OF SECTION

HW SET NO: 7

DOOR NUMBER: (Includes but is not limited to the following doors) 3A.001A, 3A.002A, 3A.003A, 3A.004A, 3A.005A, 3A.005A, 3A.006A, 3A.007A, 3A.008A, 3A.009A, 3A.010A, 3A.023A, 3A.025A, 3A.026A, 3A.026B, 3A.029A, 3A.031A, 3A.033A, 3A.035A

HARDWARE BY DOOR MFG** B/O

HW SET NO: 12.1

DOOR NUMBER: (Includes but is not limited to the following doors)

3A.021A

1 EA	CONT. HINGE	700	630	IVE
1 EA	PASSAGE SET	L9010L 07A	630	SCH
1 EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1 EA	WALL STOP	WS407CCV	630	IVE
1 EA	GASKETING	188S-BK	S-Bk	ZER

HW SET NO: 31

DOOR NUMBER: (Includes but is not limited to the following doors)

3E.400A

3 EA	HINGE	3CB1 4.5 X 4.5	630	IVE
1 EA	STOREROOM LOCK	LV9080L 07A	630	SCH
1 EA	MORTISE CYLINDER	MARK X4 SFIC	626	MED
1 EA	SURFACE CLOSER	4011 MC TBWMS	689	LCN
1 EA	KICK PLATE	8400 10" X 2" LDW B4E	630	IVE
1 EA	WALL STOP	WS407CCV	630	IVE
1 EA	GASKETING	188S-BK	S-Bk	ZER

HW SET NO: 44

DOOR NUMBER: (Includes but is not limited to the following doors)

3A.001A, 3A.021A, 3A.022A

3 EA 1 EA 1 EA 1 EA 3 EA	HINGE PASSAGE SET KICK PLATE WALL STOP SII ENCER	3CB1 4.5 X 4.5 L9010 07A 8400 10" X 2" LDW B4E WS407CCV SR64	630 630 630 630 GY	IVE SCH IVE IVE
3 EA	SILENCER	SR64	GY	IVE

^{**}AURORA SLIDING DOOR SYSTEM INCLUDING TRACK, HARDWARE AND POST PULLS

HW SET NO: 57.1

DOOR NUMBER: (Includes but is not limited to the following doors)

3A.02A, 3A.000A

1 EA	CONT. HINGE	700 EPT		630	IVE
1 EA	POWER TRANSFER	EPT10	M	689	VON
1 EA	ELEC FIRE EXIT	LX-RX-QEL-98-L-F-07-SNB	M	626	VON
	HARDWARE				
1 EA	RIM CYLINDER	MARK X4 SFIC		626	MED
1 EA	SURF. AUTO	4642 CS	N	689	LCN
2 EA	OPERATOR	8310-813		630	LCN
	ACTUATOR, WALL		N		
	MOUNT				
1 EA	KICK PLATE	8400 10" X 2" LDW B4E		630	IVE
1 EA	WALL STOP	WS407CCV		630	IVE
1 EA	GASKETING	188S-BK		S-Bk	ZER
1	POWER SUPPLY	BY SECURITY INTEGRATOR	N		B/O
1	CARD READER	WORK OF DIVISION 28 BY DIV 26	N		B/O
1 EA	REMOTE RELEASE	WORK OF DIVISION 28BY DIV 26	N		B/O

ENTRANCE BY REMOTE RELEASE OR CARD READER. USER PRESENTS CREDENTIAL, EXIT DEVICELATCH RETRACTS, EXTERIOR ACTUATOR TURNS ON. USER EITHER 'WAVES' ACTUATOR TO OPEN DOOR, OR PULLS LEVER TO OPEN. TO EXIT USER 'WAVES' ACTUATOR EXIT DEVICE LATCH RETRACTS, AUTO OPERATOR OPENS DOOR, OR USER PUSHES EXIT DEVICE BAR AND OPENS DOORMANUALLY.

SECTION 08 8000 GLAZING

PART 1 - GENERAL

1.01. RELATED DOCUMENTS:

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

1.02. SUMMARY:

- A. Extent of glass and glazing work is indicated on drawings and schedules.
- B. Types of glass and glazing work include the following:
 - Doors.
 - 2. Interior borrowed lites.
- C. Related sections include the following:
 - 1. Division 8 Section "Decorative Glazing" for decorative glazing for interior storefront applications.
 - 2. Division 13 Section "Radiation Protection" for radiation shielding leaded glass.

1.03. SYSTEM DESCRIPTION:

- A. Provide glass and glazing that has been produced, fabricated and installed to withstand normal thermal movement, wind loading and impact loading (where applicable), without failure including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glass and glazing materials and other defects in the work.
 - 1. Normal thermal movement is defined as that resulting from an ambient temperature range of 120 deg. F (67 deg. C) and from a consequent temperature range within glass and glass framing members of 180 deg. F (100 deg. C).
 - Deterioration of insulating glass is defined as failure of hermetic seal due to other
 causes than breakage which results in intrusion of dirt or moisture, internal
 condensation or fogging, deterioration of protected internal glass coating, if any,
 resulting from seal failure, and any other visual evidence of seal failure or performance.

1.04. SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.
- C. Glazing Accessory Samples: For gaskets sealants and colored spacers, in 12-inch (300-mm) lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system.
- D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- E. Qualification Data: For installers and manufacturers of insulating-glass units with sputter-coated, low-e coatings.
- F. Product Certificates: For glass and glazing products, from manufacturer.
- G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for insulating glass glazing sealants and glazing gaskets.
 - 1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
- H. Preconstruction adhesion and compatibility test report.
- I. Warranties: Sample of special warranties.

1.05. QUALITY ASSURANCE:

- A. Glazing Standards: Comply with recommendations of Flat Glass Marketing Association (FGMA) "Glazing Manual" and "Sealant Manual" except where more stringent requirements are indicated. Refer to those publications for definitions of glass and glazing terms not otherwise defined in this section or other referenced standards.
- B. Safety Glazing Standard: Where safety glass is indicated or required by authorities having jurisdiction, provide type of products indicated which comply with ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for category II materials.
 - 1. Subject to compliance with requirements, provide safety glass permanently marked with certification label of Safety Glazing Certification Council (SGCC) or other certification agency acceptable to authorities having jurisdiction.

1.06. DELIVERY, STORAGE, AND HANDLING:

- A. Protect glass and glazing materials during delivery, storage and handling to comply with manufacturer's directions and as required to prevent edge damage to glass, and damage to glass and glazing materials from effects of moisture including condensation, of temperature changes, of direct exposure to sun, and from other causes.
 - 1. Where insulating glass units will be exposed to substantial altitude changes, avoid hermetic seal ruptures by complying with insulating glass fabricator's recommendations for venting and sealing.

1.07. PROJECT CONDITIONS:

- A. Environmental Conditions: Do not proceed with glazing when ambient and substrate temperature conditions are outside the limits permitted by glazing material manufacturer or when joint substrates are wet due to rain, frost, condensation or other causes.
 - Install liquid sealants at ambient and substrate temperatures above 40 deg. F (4.4 deg. C).

PART 2 - PRODUCTS

2.01. GLASS PRODUCTS. GENERAL:

- A. Primary Glass Standard: Provide primary glass which complies with ASTM C 1036 requirements, including those indicated by reference to type, class, quality, and, if applicable, form, finish, mesh and pattern.
- B. Heat-Treated Glass Standard: Provide heat-treated glass which complies with ASTM C 1048 requirements, including those indicated by reference to kind, condition, type, quality, class, and, if applicable, form, finish, and pattern.
- C. Sizes: Fabricate glass to sizes required for glazing openings indicated, with edge clearances and tolerances complying with recommendations of glass manufacturer. Provide thicknesses indicated or, if not otherwise indicated, as recommended by glass manufacturer for application indicated.

2.02. PRIMARY GLASS PRODUCTS:

A. Clear Float Glass: ASTM C 1036, Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select).

2.03. HEAT-TREATED GLASS PRODUCTS:

- A. Manufacturing Process: Manufacture heat-treated glass as follows:
 - 1. By horizontal (roller hearth) process with roll wave distortion parallel with bottom edge of glass as installed, unless otherwise indicated.
- B. Uncoated Clear Heat-Treated Float Glass: ASTM C 1048; Condition A (uncoated surfaces), Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select), kind as indicated below.

1. Provide Kind HS (heat-strengthened) coated float glass, except provide Kind FT (fully tempered) products where safety glass is indicated.

2.04. ELASTOMERIC GLAZING SEALANTS:

- A. General: Provide products of type indicated and complying with the following requirements:
 - 1. Compatibility: Select glazing sealants and tapes of proven compatibility with other materials with which they will come into contact, including glass products, seals of insulating glass units, and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.
 - 2. Suitability: Comply with recommendations of sealant and glass manufacturers for selection of glazing sealants and tapes which have performance characteristics suitable for applications indicated and conditions at time of installation.
 - 3. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealant of base polymer indicated which complies with ASTM C 920 requirements, including those for Type, Grade, Class and Uses.
 - 4. Colors: Provide color of exposed sealants indicated or, if not otherwise indicated, as selected by Architect from manufacturer's standard colors.
- B. One-Part Non-Acid-Curing Silicone Glazing Sealant: Type S; Grade NS, Class 25; Uses NT, G, A, and, as applicable to uses indicated, O; and complying with the following requirements for modulus and additional joint movement capability.
 - 1. Medium Modulus: Tensile strength of not less than 45 nor more than 75 psi at 100 percent elongation when tested per ASTM D 412 after 14 days at 77 deg. F (20 deg. C) and 50 percent relative humidity.
- C. Products: Subject to compliance with requirements, provide one of the following:
 - 1. One-Part Non-Acid Curing Medium-Modulus Silicone Glazing Sealant:
 - a. "Dow Corning 795"; Dow Corning Corp.
 - b. "Silpruf"; General Electric Corp.
 - c. "Spectrum 2"; Tremco, Inc.

2.05. MISCELLANEOUS GLAZING MATERIALS:

- A. Compatibility: Provide materials with proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealants, 80 to 90 Shore A durometer hardness.
- D. Spacers: Neoprene, EPDM UV resistant PVC or silicone blocks, or continuous extrusions, as required for compatibility with glazing sealant, of size, shape and hardness recommended by glass and sealant manufacturers for application indicated.
- E. Edge Blocks: Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealant, of size and hardness required to limit lateral movement (side-walking) of glass.
- F. Compressible Filler Rods: Open cell, closed-cell or waterproof-jacketed rod stock of synthetic rubber or plastic foam, flexible and resilient, with 5-10 psi compression strength for 25 percent deflection.

PART 3 - EXECUTION

3.01. EXAMINATION:

A. Require Glazier to inspect work of glass framing erector for compliance with manufacturing and installation tolerances, including those for size, squareness, offsets at corners; for presence and functioning of weep system; for existence of minimum required face or edge clearances; and for effective sealing of joinery. Obtain Glazier's written report listing

conditions detrimental to performance of glazing work. Do not allow glazing work to proceed until unsatisfactory conditions have been corrected.

3.02. PREPARATION:

- A. Pre-Installation Meeting: At Contractor's direction, Glazier, sealant and gasket manufacturers' technical representatives, glass framing erector and other trades whose work affects glass and glazing shall meet at project site to review procedures and time schedule proposed for glazing and coordination with other work.
- B. Clean glazing channels and other framing members to receive glass, immediately before glazing. Remove coatings which are not firmly bonded to substrates. Remove lacquer from metal surfaces where elastomeric sealants are indicated for use.

3.03. GLAZING, GENERAL:

- A. Comply with combined printed recommendations of glass manufacturers, of manufacturers of sealants, gaskets and other glazing materials, except where more stringent requirements are indicated, including those of referenced glazing standards.
- B. Glazing channel dimensions as indicated in details are intended to provide for necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by job conditions at time of installation.
- C. Protect glass from edge damage during handling and installation; use a rolling block in rotating glass units to prevent damage to glass corners. Do not impact glass with metal framing. Use suction cups to shift glass units within openings; do not raise or drift glass with a pry bar. Rotate glass with flares or bevels along one horizontal edge which would occur in vicinity of setting blocks so that these are located at top of opening. Remove from project and dispose of glass units with edge damage or other imperfections of kind that, when installed, weakens glass and impairs performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants.

3.04. GLAZING:

- A. Install setting blocks of proper size in sill rabbet, located one quarter of glass width from each corner, but with edge nearest corner not closer than 6" from corner, unless otherwise required. Set blocks in thin course of sealant which is acceptable for heel bead use.
- B. Provide spacers inside and out, of correct size and spacing to preserve required face clearances, for glass sizes larger than 50 united inches (length plus height), except where gaskets or glazing tapes with continuous spacer rods are used for glazing. Provide 1/8" minimum bite of spacers on glass and use thickness equal to sealant width, except with sealant tape use thickness slightly less than final compressed thickness of tape.
- C. Provide edge blocking to comply with requirements of referenced glazing standard, except where otherwise required by glass unit manufacturer.
- D. Set units of glass in each series with uniformity of pattern, draw, bow and similar characteristics.
- E. Provide compressible filler rods or equivalent back-up material, as recommended by sealant and glass manufacturers, to prevent sealant from extruding into glass channel weep systems and from adhering to joints back surface as well as to control depth of sealant for optimum performance, unless otherwise indicated.
- F. Force sealants into glazing channels to eliminate voids and to ensure complete "wetting" or bond of sealant to glass and channel surfaces.
- G. Tool exposed surfaces of sealants to provide a substantial "wash" away from glass. Install pressurized tapes and gaskets to protrude slightly out of channel, so as to eliminate dirt and moisture pockets.

- H. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage to ensure that gasket will not "walk" out when installation is subjected to movement.
- I. Miter cut wedge-shaped gaskets at corners and install gaskets in manner recommended by gasket manufacturer to prevent pull away at corners; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.05. PROTECTION AND CLEANING:

- A. Protect glass from breakage immediately upon installation by use of crossed streamers attached to framing and held away from glass. Do not apply markers to surfaces of glass. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If substances do come into contact with glass, remove immediately by method recommended by glass manufacturer.
- C. Remove and replace glass which is broken, chipped, cracked, abraded or damaged in other ways during construction period, including natural causes, accidents and vandalism.
- D. Wash glass on both faces not more than 4 days prior to date scheduled for inspections intended to establish date of substantial completion in each area of project. Wash glass by method recommended by glass manufacturer.

3.06. GLAZING TYPES

- A. Interior Windows: 1/4 inch clear float glass.
- B. Interior Windows, Tempered: 1/4 inch clear float glass, Kind FT (fully-tempered).

END OF SECTION

SECTION 09 2115 GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.01. RELATED DOCUMENTS

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

1.02. SUMMARY

- A. This Section includes the following:
 - 1. Nonload-bearing steel framing members for gypsum board assemblies.
 - 2. Gypsum board assemblies attached to steel framing.
 - 3. Tile backing panels.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 9 Sections for gypsum fabrications.

1.03. DEFINITIONS

A. Gypsum Board Construction Terminology: Refer to ASTM C 11 and GA-505 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.04. ASSEMBLY PERFORMANCE REQUIREMENTS

- A. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those of assemblies whose STC ratings were determined according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.
- B. Fire Resistance: Provide gypsum board assemblies with fire-resistance ratings indicated.

1.05. SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for each type of product specified.
- C. Shop Drawings showing locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of Work. Locations of abuse resistant gypsum panels where applicable.
 - Show layout of radiation-protected areas. Indicate lead thickness or lead equivalence
 of components. Show components and installation conditions not fully dimensioned or
 detailed in Product Data.
- D. Product certificates signed by manufacturers of gypsum board assembly components certifying that their products comply with specified requirements.

1.06. QUALITY ASSURANCE

- A. Single-Source Responsibility for Steel Framing: Obtain steel framing members for gypsum board assemblies from a single manufacturer, unless otherwise indicated.
- B. Single-Source Responsibility for Panel Products: Obtain each type of gypsum board and other panel products from a single manufacturer.
- C. Single-Source Responsibility for Finishing Materials: Obtain finishing materials from either the same manufacturer that supplies gypsum board and other panel products or from a manufacturer acceptable to gypsum board manufacturer.
- D. Fire-Test-Response Characteristics: Where fire-resistance-rated gypsum board assemblies are indicated, provide gypsum board assemblies that comply with the following requirements:
 - Fire-Resistance Ratings: As indicated by GA File Numbers in GA-600 "Fire Resistance
 Design Manual" or design designations in UL "Fire Resistance Directory" or in the
 listing of another testing and inspecting agency acceptable to authorities having
 jurisdiction.

- 2. Gypsum board assemblies indicated are identical to assemblies tested for fire resistance according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
- 3. Deflection and Firestop Track: Top runner provided in fire-resistance-rated assemblies indicated is labeled and listed by UL, Warnock Hersey, or another testing and inspecting agency acceptable to authorities having jurisdiction.
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to radiation protection including, but not limited to, the following:
 - 1. Sequence and schedule of radiation protection work in relation to other work.
 - 2. Supplementary lead shielding at duct, pipe, and conduit penetrations of radiation protection, if required.
 - 3. Methods of attaching other construction and equipment to lead-lined finishes.
 - 4. Notification procedures for work that requires modifying radiation protection.

1.07. DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Neatly stack gypsum panels flat to prevent sagging.

1.08. PROJECT CONDITIONS

- A. Environmental Conditions, General: Establish and maintain environmental conditions for applying and finishing gypsum board to comply with ASTM C 840 requirements or gypsum board manufacturer's recommendations, whichever are more stringent.
- B. Room Temperatures: For nonadhesive attachment of gypsum board to framing, maintain not less than 40 deg F (4 deg C). For adhesive attachment and finishing of gypsum board, maintain not less than 50 deg F (10 deg C) for 48 hours before application and continuously after until dry. Do not exceed 95 deg F (35 deg C) when using temporary heat sources.
- C. Ventilation: Ventilate building spaces as required to dry joint treatment materials. Avoid drafts during hot, dry weather to prevent finishing materials from drying too rapidly.

PART 2 - PRODUCTS

2.01. MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Steel Framing and Furring:
 - a. CEMCO; California Expanded Metal Products Co.
 - b. MarinoWARE.
 - c. MBA Building Supplies.
 - d. MRI Steel Framing, LLC.
 - e. Phillips Manufacturing Co.
 - f. SCAFCO Steel Stud Company.
 - g. Steel Construction Systems. 8) Steel Network, Inc. (The).
 - 2. Grid Suspension Assemblies:
 - a. Armstrong World Industries, Inc.
 - b. Chicago Metallic Corp.
 - c. USG Interiors, Inc.
 - d. Worthington Steel Company (formerly National Rolling Mills).
 - 3. Gypsum Board and Related Products:
 - a. American Gypsum.
 - b. CertainTeed Corporation.
 - c. Georgia-Pacific Building Products.
 - d. National Gypsum Company.
 - e. PABCO Gypsum.

- f. Temple-Inland Building Products by Georgia-Pacific.
- g. USG Corporation.
- 2.02. STEEL FRAMING COMPONENTS FOR SUSPENDED AND FURRED CEILINGS
 - A. General: Provide components complying with ASTM C 754 for conditions indicated.
 - B. Wire Ties: ASTM A 641 (ASTM A 641M), Class 1 zinc coating, soft temper, 0.062 inch (1.6 mm) thick.
 - C. Wire Hangers: ASTM A 641 (ASTM A 641M), Class 1 zinc coating, soft temper, 0.162-inch (4.1-mm) diameter.
 - D. Grid Suspension System for Interior Ceilings: ASTM C 645, manufacturer's standard directhung grid suspension system composed of main beams and cross-furring members that interlock to form a modular supporting network.
- 2.03. STEEL FRAMING FOR WALLS AND PARTITIONS
 - A. General: Provide steel framing members complying with the following requirements:
 - 1. Protective Coating: ASTM A 653, G 40 (ASTM A 653M, Z 90) hot-dip galvanized coating.
 - B. Steel Studs and Runners: ASTM C 645, with flange edges of studs bent back 90 degrees and doubled over to form 3/16-inch- (5-mm-) wide minimum lip (return), and complying with the following requirements for minimum thickness of base (uncoated) metal and for depth:
 - 1. Thickness: 0.0396 inch (20 gauge, minimum EQ Studs not allowed) as follows:
 - a. For head runner, sill runner, jamb, and cripple studs at door and other openings.
 - b. Depth: As indicated.
 - C. Deflection Track: Manufacturer's standard top runner designed to prevent cracking of gypsum board applied to interior partitions resulting from deflection of the structure above fabricated from steel sheet complying with ASTM A 653 (ASTM A 653M) or ASTM A 568 (ASTM A 568M). Thickness as indicated for studs, and width to accommodate depth of studs, and of the following configuration:
 - 1. Top runner with 2-1/2-inch- (63.5-mm-) deep flanges that either have V-shaped offsets that compress when pressure is applied from construction above or have slots 1 inch (25.4 mm) o.c. that allow fasteners attached to studs through the slots to accommodate structural movement by slipping.
 - a. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - 1) Superior Flex Track System (SFT); Delta Star, Inc.
 - 2) SLP-TRK; Metal-Lite, Inc.
 - D. Deflection and Firestop Track: Top runner designed to allow partition heads to expand and contract with movement of structure above while maintaining continuity of the assembly. Comply with requirements of ASTM C 645 except configuration, of thickness indicated for studs and width to accommodate depth of studs indicated with flanges offset at midpoint to accommodate gypsum board thickness.
 - 1. Offset Configuration: As indicated.
 - 2. Available Product: Subject to compliance with requirements, a product that may be incorporated in the Work includes, but is not limited to, "Fire Trak" manufactured by Fire Trak Corp.
 - E. Steel Rigid Furring Channels: ASTM C 645, hat shaped, depth and minimum thickness of base (uncoated) metal as follows:
 - 1. Thickness: 0.0336 inch (0.84 mm), unless otherwise indicated.
 - 2. Depth: 1-1/2 inch (38.1 mm).
 - F. Steel Flat Strap and Backing Plate: Steel sheet for blocking and bracing complying with ASTM A 653 (ASTM A 653M) or ASTM A 568 (ASTM A 568M), length and width as indicated, and with a minimum base metal (uncoated) thickness as follows:
 - 1. Thickness: 0.0635 inch (1.5 mm) where indicated.
 - G. Fasteners for Metal Framing: Provide fasteners of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel framing and furring members

securely to substrates involved; complying with the recommendations of gypsum board manufacturers for applications indicated.

2.04. GYPSUM BOARD PRODUCTS

- A. General: Provide gypsum board of types indicated in maximum lengths available that will minimize end-to-end butt joints in each area indicated to receive gypsum board application.
 - 1. Widths: Provide gypsum board in widths of 48 inches (1219 mm).
- B. Gypsum Wallboard: ASTM C 36 and as follows:
 - 1. Type: Type X typical unless noted otherwise.
 - 2. Edges: Tapered and featured (rounded or beveled) for prefilling.
 - 3. Thickness: 5/8 inch (15.9 mm) where indicated.
- C. Gypsum Board Base Layer(s) for Multilayer Applications: Gypsum wallboard, ASTM C 36, and as follows:
 - 1. Type: Type X typical unless noted otherwise.
 - 2. Edges: Manufacturer's standard.
 - 3. Thickness: 5/8 inch (15.9 mm) where indicated.

2.05. TILE BACKING PANELS

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated. B. Glass-Mat, Water-Resistant Backing Board:
 - 1. Complying with ASTM C 1178/C 1178M.
 - Product: Subject to compliance with requirements, provide "DensShield Tile Guard" by G-P Gypsum.
 - 2. Core: 5/8 inch (15.9 mm), Type X.

2.06. TRIM ACCESSORIES

- A. Accessories for Interior Installation: Cornerbead, edge trim, and control joints complying with ASTM C 1047 and requirements indicated below:
 - 1. Material: Formed metal or plastic, with metal complying with the following requirement:
 - a. Steel sheet zinc coated by hot-dip process or rolled zinc.
 - b. Shapes indicated below by reference to Fig. 1 designations in ASTM C 1047:
 - c. Cornerbead on outside corners, unless otherwise indicated.
 - d. LC-bead with both face and back flanges; face flange formed to receive joint compound. Use LC-beads for edge trim, unless otherwise indicated.
 - e. LK-bead with square nose for use with kerfed joints.
 - f. L-bead with face flange only; face flange formed to receive joint compound. Use L-bead where indicated.
 - g. U-bead with face and back flanges; face flange formed to be left without application of joint compound. Use U-bead where indicated.
 - One-piece control joint formed with V-shaped slot and removable strip covering slot opening.
- B. Accessory for Curved Edges: Cornerbead formed of metal, plastic, or metal combined with plastic, with either notched or flexible flanges that are bendable to curvature radius.

2.07. JOINT TREATMENT MATERIALS

- A. General: Provide joint treatment materials complying with ASTM C 475 and the recommendations of both the manufacturers of sheet products and of joint treatment materials for each application indicated.
- B. One-Piece Control Joints: Formed with vee-shaped slot per Fig. 1 in ASTM C 1047, with slot opening covered with removable strip.
- C. Channel Screeds and Reveal Molding:
 - 1. Fry Reglet Reveal Channel Screed, as indicated on drawings.
 - a. Material: Extruded aluminum alloy 6063 T5, with chemical conversion coating.
 - b. Finish: As indicated on drawings or in Finish Legend.
 - c. Depth and Width: As indicated on drawings.
 - 2. Fry Reglet "F" Reveal, as indicated on drawings.

- a. Material: Extruded aluminum alloy 6063 T5, with chemical conversion coating.
- b. Finish: As indicated on drawings or in Finish Legend.
- c. Depth and Width: As indicated on drawings.
- D. Joint Tape for Gypsum Board: Paper reinforcing tape, unless otherwise indicated.
 - 1. Use paper tape with compatible joint compound where recommended by manufacturer of gypsum board and joint treatment materials for application indicated.
- E. Joint Compounds for Gypsum Board one of the following types may be used at the Contractor's option.
 - 1. Setting type Factory-packaged, job-mixed, chemical-hardening powder products formulated for uses indicated.
 - a. For taping and filling only, use formulation that is compatible with other joint compounds applied over it.
 - b. For prefilling gypsum board joints, use formulation recommended by gypsum board manufacturer.
 - c. For filling joints and treating fasteners of water-resistant gypsum backing board behind base for ceramic tile, use formulation recommended by gypsum board manufacturer.
 - d. For topping compound, use sandable formulation.
 - 2. Drying-Type Joint Compounds for Gypsum Board: Factory-packaged vinyl-based products complying with the following requirements for formulation and intended use.
 - a. Ready-Mixed Formulation: Factory-mixed product.
 - 1) Taping compound formulated for embedding tape and for first coat over fasteners and face flanges of trim accessories.
 - 2) Topping compound formulated for fill (second) and finish (third) coats.
 - 3) All-purpose compound formulated for both taping and topping compounds
- F. Joint Compounds for Ceilings: Special finishing based on USG.

2.08. ACOUSTICAL MATERIALS

- A. Acoustical Tape: Closed cell, 1/4 inch minimum thickness, or thicker as detailed, preformed PVC foam tape, adhesive backed, "Norseal V730", Norton Specialty Plastics Division.
- B. Acoustic Sealant Pads: Resilient pads, composed of polybutene-butyl and inert fillers, "Lowry Outlet Box Pads", Harry A. Lowry & Associates, Van Nuys, California 91406, or approved equal.
- C. Acoustical Sealant: Permanently plastic, non-hardening, non-skinning, non-bleeding, nonstaining sealant; "Acoustical Sealant", as manufactured by Tremco, United States Gypsum, Presstite Products, or approved equal.
 - 1. VOC Content: Less than 50 grams per liter.
- D. Acoustical Gaskets: Closed-cell neoprene rubber, black, 12 pcf density, thickness as shown; Williams Products Co., 1040 Series, Type NN1.
- E. Sound-Attenuation Blankets: Unfaced mineral-fiber blanket insulation produced by combining mineral fibers of type described below with thermosetting resins to comply with ASTM C 665 for Type I (blankets without membrane facing).
 - 1. Mineral-Fiber Type: Fibers manufactured from glass.

2.09. MISCELLANEOUS MATERIALS

- A. General: Provide auxiliary materials for gypsum board construction that comply with referenced standards and recommendations of gypsum board manufacturer.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
 - 1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Steel drill screws complying with ASTM C 1002 for the following applications:
 - 1. Fastening gypsum board to steel members less than 0.033 inch (0.84 mm) thick.
 - 2. Fastening gypsum board to gypsum board.

D. Steel drill screws complying with ASTM C 954 for fastening gypsum board to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.

PART 3 - EXECUTION

3.01. EXAMINATION

- A. Examine substrates to which gypsum board assemblies attach or abut, installed hollow metal frames, cast-in-anchors, and structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of assemblies specified in this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine substrates in areas to receive radiation protection, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of radiation protection. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02. PREPARATION

- A. Ceiling Anchorages: Coordinate installation of ceiling suspension systems with installation of overhead structural assemblies to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers that will develop their full strength and at spacing required to support ceilings.
 - 1. Furnish devices indicated to other trades for installation well in advance of time needed for coordination with other construction.

3.03. INSTALLING STEEL FRAMING, GENERAL

- A. Steel Framing Installation Standard: Install steel framing to comply with ASTM C 754 and with ASTM C 840 requirements that apply to framing installation.
 - 1. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnish-ings, or similar construction. Comply with details indicated and with recommendations of gypsum board manufacturer or, if none available, with United States Gypsum Co.'s "Gypsum Construction Handbook."
 - 2. Install deflection track top runner to attain lateral support and avoid axial loading.
 - 3. Install deflection and firestop track top runner at fire-resistance-rated assemblies where indicated.
 - a. Attach jamb studs at openings to tracks using manufacturer's standard stud clip.
- B. Do not bridge building control and expansion joints with steel framing or furring members. Independently frame both sides of joints with framing or furring members as indicated.

3.04. INSTALLING STEEL FRAMING FOR SUSPENDED AND FURRED CEILINGS

- A. Suspend ceiling hangers from building structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
 - 3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.
 - 4. Secure flat, angle, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for structure as well as for type of hanger involved, and in a manner that will not cause them to deteriorate or otherwise fail.

- 5. Do not attach hangers to steel deck tabs.
- 6. Do not attach hangers to steel roof deck. Attach hangers to structural members.
- 7. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- B. Sway-brace suspended steel framing with hangers used for support.
- C. Install suspended steel framing components in sizes and at spacings indicated, but not less than that required by the referenced steel framing installation standard.
 - 1. Wire 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.
- D. Installation Tolerances: Install steel framing components for suspended ceilings so that crossfurring or grid suspension members are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) as measured both lengthwise on each member and transversely between parallel members.
- E. Wire-tie or clip furring members to main runners and to other structural supports as indicated.
- F. Grid Suspension System: Attach perimeter wall track or angle where grid suspension system meets vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

3.05. INSTALLING STEEL FRAMING FOR WALLS AND PARTITIONS

- A. Install runners (tracks) at floors, ceilings, and structural walls and columns where gypsum board stud assemblies abut other construction.
 - 1. Where studs are installed directly against exterior walls, install asphalt felt strips or foam gaskets between studs and wall.
- B. Installation Tolerances: Install each steel framing and furring member so that fastening surfaces do not vary more than 1/8 inch (3 mm) from the plane formed by the faces of adjacent framing.
- C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
 - For STC-rated and fire-resistance-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid structural surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed, to support gypsum board closures needed to make partitions continuous from floor to underside of solid structure.
- D. Terminate partition framing at suspended ceilings only where indicated.
- E. Install steel studs and furring in sizes and at spacings indicated.
 - Single-Layer Construction: Space studs 16 inches (406 mm) o.c., unless otherwise indicated.
 - 2. Multilayer Construction: Space studs 24 inches (610 mm) o.c., unless otherwise indicated.
- F. Install steel studs so flanges point in the same direction and leading edge or end of each gypsum board panel can be attached to open (unsupported) edges of stud flanges first.
 - Position studs vertically with open sides facing in same direction and engaging floor and ceiling runners. Begin and end each arc with a stud and space intermediate studs equally along arcs at stud spacing recommended by gypsum board manufacturer for radii indicated. Attach studs to runners with 3/8-inch- (9.5-mm-) long pan head framing screws. On straight lengths at ends of arcs, place studs 6 inches (150 mm) o.c. with last stud left free standing.
- G. Frame door openings to comply with GA-219, and with applicable published recommendations of gypsum board manufacturer, unless otherwise indicated. Attach vertical studs at jambs with screws either directly to frames or to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

- 1. Install 2 studs at each jamb, unless otherwise indicated.
- 2. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (12.7mm) clearance from jamb stud to allow for installation of control joint.
- 3. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.
- H. Frame openings other than door openings to comply with details indicated or, if none indicated, as required for door openings. Install framing below sills of openings to match framing required above door heads.
- Install insulation as follows:
 - 1. Erect insulation vertically and hold in place with friction fit or supplemental clips if required.

3.06. APPLYING AND FINISHING GYPSUM BOARD, GENERAL

- A. Gypsum Board Application and Finishing Standards: Install and finish gypsum panels to comply with ASTM C 840 and GA-216.
- B. Install sound-attenuation blankets, where indicated, prior to installing gypsum panels unless blankets are readily installed after panels have been installed on one side.
- C. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- D. Install gypsum panels with face side out. Do not install imperfect, damaged, or damp panels. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
- E. Locate both edge or end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Avoid joints other than control joints at corners of framed openings where possible.
- F. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- G. Attach gypsum panels to framing provided at openings and cutouts.
- H. Form control and expansion joints at locations indicated and as detailed, with space between edges of adjoining gypsum panels, as well as supporting framing behind gypsum panels.
- I. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases that are braced internally.
 - 1. Except where concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect open structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- J. Isolate perimeter of nonload-bearing gypsum board partitions at structural abutments, except floors, as detailed. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- K. Where STC-rated gypsum board assemblies are indicated, seal construction at perimeters, behind control and expansion joints, openings, and penetrations with a continuous bead of acoustical sealant including a bead at both faces of the partitions. Comply with ASTM C 919 and manufacturer's recommendations for location of edge trim and closing off sound-

- flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.
- L. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's recommendations.
 - 1. Space screws a maximum of 12 inches (304.8 mm) o.c. for vertical applications.
- M. Space fasteners in panels that are tile substrates a maximum of 8 inches (203.2 mm) o.c.

3.07. GYPSUM BOARD APPLICATION METHODS

- A. Single-Layer Application: Install gypsum wallboard panels as follows:
 - 1. On ceilings, apply gypsum panels prior to wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
 - 2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing), unless parallel application is required for fire-resistance-rated assemblies. Use maximum-length panels to minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of board
 - b. At stairwells and other high walls, install panels horizontally.
 - c. Install abuse resistant panels in corridors to a height of 4'-0" AFF.
- B. Wall Tile Substrates: For substrates indicated to receive ceramic tile and similar rigid applied wall finishes, comply with the following:
 - 1. Paperless Gypsum Backing Board: Install where indicated. Install with 1/4-inch (6.4mm) gap where panels abut other construction or penetrations.
 - 2. Where tile backing panels abut other types of panels in the same plane, shim surfaces to produce a uniform plane across panel surfaces.
- C. Multilayer Application on Ceilings: Apply gypsum board indicated for base layers prior to applying base layers on walls/partitions; apply gypsum wallboard face layers in same sequence. Offset face-layer joints one framing member, 16 inches (400 mm) minimum, from parallel baselayer joints. Apply base layers at right angles to framing members, unless otherwise indicated.
- D. Multilayer Application on Partitions/Walls: Apply gypsum board indicated for base layers and gypsum wallboard face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints. Stagger joints on opposite sides of partitions.
- E. Single-Layer Fastening Methods: Apply gypsum panels to supports as follows:
 - 1. Fasten with screws.
- F. Multilayer Fastening Methods: Apply base layers of gypsum panels and face layer to base layers as follows:
 - 1. Fasten both base layers and face layers separately to supports with screws.

3.08. INSTALLING TRIM ACCESSORIES

- A. General: For trim accessories with back flanges, fasten to framing with the same fasteners used to fasten gypsum board. Otherwise, fasten trim accessories according to accessory manufacturer's directions for type, length, and spacing of fasteners.
- B. Install cornerbead at external corners.
- C. Install edge trim where edge of gypsum panels would otherwise be exposed. Provide edge trim type with face flange formed to receive joint compound, except where other types are indicated.
 - 1. Install LC-bead where gypsum panels are tightly abutted to other construction and back flange can be attached to framing or supporting substrate.
 - 2. Install L-bead where edge trim can only be installed after gypsum panels are installed.
 - 3. Install U-bead where indicated.
 - 4. Install aluminum trim and other accessories where indicated.
- D. Install control joints according to ASTM C 840 and manufacturer's recommendations and in specific locations approved by Architect for visual effect.

E. Install metal reveals and trim in locations indicated. Coordinate with adjacent contrasting finish materials.

3.09. FINISHING GYPSUM BOARD ASSEMBLIES

- A. General: Treat gypsum board joints, interior angles, flanges of cornerbead, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration.
- B. Prefill open joints, rounded or beveled edges, and damaged areas using setting-type joint compound.
- C. Apply joint tape over gypsum board joints, except those with trim accessories having flanges not requiring tape.
- D. Levels of Gypsum Board Finish: Provide the following levels of gypsum board finish per GA214.
 - 1. Level 1 for ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
 - 2. Level 2 where water-resistant gypsum backing board panels form substrates for tile, and where indicated.
 - 3. Level 4 for gypsum board surfaces, unless otherwise indicated.
 - 4. Level 5 for gypsum board surfaces where indicated to receive smooth finish or wall wash light fixtures.
- E. Use one of the following joint compound combinations as applicable to the finish levels specified:
 - 1. Embedding and First Coat: Setting-type joint compound.
 - 2. Fill (Second) Coat: Setting-type joint compound.
 - 3. Finish (Third) Coat: Sandable, setting-type joint compound.
- F. For Level 4 gypsum board finish, embed tape in joint compound and apply first, fill (second), and finish (third) 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.
- G. Where Level 1 gypsum board finish is indicated, embed tape in joint compound.
- H. Finish tile backer units to comply with unit manufacturer's directions.

3.10. FIELD QUALITY CONTROL

- A. Above-Ceiling Observation: Architect will conduct an above-ceiling observation prior to installation of gypsum board ceilings and report any deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.
 - 1. Notify Architect one week in advance of the date and the time when the Project, or part of the Project, will be ready for an above-ceiling observation.
 - 2. Prior to notifying Architect, complete the following in areas to receive gypsum board ceilings:
 - a. Installation of 80 percent of lighting fixtures, powered for operation.
 - b. Installation, insulation, and leak and pressure testing of water piping systems.
 - c. Installation of air duct systems.
 - d. Installation of air devices.
 - e. Installation of mechanical system control air tubing.
 - f. Installation of ceiling support framing.
- B. Testing: After radiology equipment has been installed and placed in operating condition, Owner will engage a radiation health physicist to test radiation protection. Correct deficiencies in or remove and replace radiation protection that testing indicates does not comply with specified requirements, including finishes and other work covering defective work. Lock radiation-protected rooms once doors and locks are installed and limit access to only those persons performing work in the rooms.

3.11. CLEANING AND PROTECTION

- A. Promptly remove any residual joint compound from adjacent surfaces.B. Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure gypsum board assemblies are without damage or deterioration at the time of Substantial Completion.

END OF SECTION

SECTION 09 5113 ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.01. RELATED DOCUMENTS

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

1.02. SUMMARY

A. This Section includes ceilings consisting of acoustical panels and exposed suspension systems – heavy duty to comply with IBC requirements.

1.03. SUBMITTALS

- A. Product Data: For each type of product specified.
- B. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:
 - 1. Ceiling suspension system members.
 - 2. Method of attaching suspension system hangers to building structure.
 - 3. Ceiling-mounted items including light fixtures; air outlets and inlets; speakers; sprinklers; and special moldings at walls, column penetrations, and other junctures of acoustical ceilings with adjoining construction.
 - 4. Minimum Drawing Scale: 1/8 inch = 1 foot (1:96).
- C. Samples for Initial Selection: Manufacturer's color charts consisting of actual acoustical panels or sections of acoustical panels, suspension systems, and moldings showing the full range of colors, textures, and patterns available for each type of ceiling assembly indicated.
- D. Samples for Verification: Full-size units of each type of ceiling assembly indicated; in sets for each color, texture, and pattern specified, showing the full range of variations expected in these characteristics.
 - 1. 6-inch- (150-mm-) square samples of each acoustical panel type, pattern, and color.
 - 2. Set of 12-inch- (300-mm-) long samples of exposed suspension system members, including moldings, for each color and system type required.
- E. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- F. Product Test Reports: Indicate compliance of acoustical panel ceilings and components with requirements based on comprehensive testing of current products.
- G. Research/Evaluation Reports: Evidence of acoustical panel ceiling's and components' compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

1.04. QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed acoustical panel ceilings similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Adhesives and Sealants: For products applied on site and located inside the weatherproofing system, comply with the VOC content limits noted in Section 018113 "Sustainable Design Requirements".
- C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- D. Source Limitations for Ceiling Units: Obtain each acoustical ceiling panel from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

- E. Source Limitations for Suspension System: Obtain each suspension system from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
 - Obtain both acoustical ceiling panels and suspension system from the same manufacturer.
- F. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:
 - 1. Fire-response tests were performed by UL, ITS/Warnock Hersey, or another independent testing and inspecting agency that is acceptable to authorities having jurisdiction and that performs testing and follow-up services.
 - 2. Surface-burning characteristics of acoustical panels comply with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84.
 - 3. Fire-resistance-rated assemblies, which are indicated by design designations from UL's "Fire Resistance Directory," from ITS/Warnock Hersey's "Directory of Listed Products," or from the listings of another testing and inspecting agency, are identical in materials and construction to those tested per ASTM E 119.
 - 4. Products are identified with appropriate markings of applicable testing and inspecting agency.
- G. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."

1.05. DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels and suspension system components to Project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.06. PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.07. COORDINATION

A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.08. EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
- B. Acoustical Ceiling Units: Full-size units equal to 2.0 percent but not less than 4 panels minimum of amount installed for each panel type.
- C. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of amount installed.

PART 2 - PRODUCTS

2.01. MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, those indicated for each designation in the Acoustical Panel Ceiling Schedule at the end of Part 3.

2.02. ACOUSTICAL PANELS, GENERAL

A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.

- 1. Mounting Method for Measuring Noise Reduction Coefficient: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface per ASTM E 795.
- B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
 - Where appearance characteristics of acoustical panels are indicated by referencing ASTM E 1264 pattern designations and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range of products that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.
- C. Panel Characteristics: Comply with requirements indicated in the Acoustical Panel Ceiling Schedule at the end of Part 3, including those referencing ASTM E 1264 classifications.

2.03. METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, heavy duty structural classification, and finishes indicated that comply with applicable ASTM C 635 requirements.
- B. Metal Suspension System Characteristics: Comply with requirements indicated in the Acoustical Panel Ceiling Schedule at the end of Part 3.
- C. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
- D. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung, unless otherwise indicated.
- E. Wire Hangers, Braces, and Ties: Provide wires at Contractor's option complying with the following requirements:
 - 1. Zinc-Coated Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 2. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.
 - 3. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, Direct Hung) will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.
- F. Seismic Bracing, Spreader Bars and Expansion Joints: As required by IBC 2003.

2.04. METAL EDGE MOLDINGS AND TRIM

- A. Basis-of-Design Product: Armstrong World Industries, Axiom. Subject to compliance with requirements, provide the product named or a comparable product by one of the following:
 - 1. Armstrong World Industries, Inc.
 - 2. Celotex Corporation (The); Building Products Division; Architectural Ceilings Marketing Dept.
 - 3. Chicago Metallic Corporation.
 - 4. Fry Reglet Corporation.
 - 5. Gordon, Inc.
 - 6. MM Systems, Inc.
 - 7. USG Interiors, Inc.
- B. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements and the following:
 - Aluminum Alloy: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of aluminum extrusions complying with ASTM B 221 (ASTM B 221M) for Alloy and Temper 6063-T5.
 - 2. Finish designations prefixed by AA comply with system established by the Aluminum Association for designating aluminum finishes.

- 3. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; organic coating: as specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.
 - a. Organic Coating: Thermosetting, primer/topcoat system with a minimum dry film thickness of 0.8 to 1.2 mils (0.02 to 0.03 mm).
- C. Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material and finish as that used for exposed flanges of suspension system runners.
 - 1. For circular penetrations of ceiling or bullnose corners, provide edge moldings fabricated to diameter required to fit penetration exactly. Exposed Face will not be stepped but shall match adjacent flat moldings. Flexible moldings may be used at bullnose corners.
 - 2. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Comply with paint manufacturer's written instructions for applying and baking and for minimum dry film thickness.
 - a. Organic Coating: Manufacturer's standard thermosetting coating system with a minimum dry film thickness of 0.8 to 1.2 mils (0.02 to 0.03 mm).
 - b. Color: Match color of finish on flanges of suspension system surfaces.

2.05. ACOUSTICAL SEALANT

- A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following requirements:
 - 1. Product is effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
- B. Acoustical Sealant for Concealed Joints: Manufacturer's standard nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), recommended for sealing interior concealed joints to reduce airborne sound transmission.
- C. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Acoustical Sealant for Exposed and Concealed Joints:
 - a. PL Acoustical Sealant; Chemrex, Inc., Contech Brands.
 - b. AC-20 FTR Acoustical and Insulation Sealant; Pecora Corp.
 - c. SHEETROCK Acoustical Sealant; United States Gypsum Co.

PART 3 - EXECUTION

3.01. EXAMINATION

- A. Examine substrates and structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage, and other conditions affecting performance of acoustical panel ceilings.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02. PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders and comply with layout shown on reflected ceiling plans.

3.03. INSTALLATION

A. General: Install acoustical panel ceilings to comply with publications referenced below per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

- Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.
- 2. CISCA's Guidelines for Systems Requiring Seismic Restraint: Comply with CISCA's "Guidelines for Seismic Restraint of Direct-Hung Suspended Ceiling Assemblies--Seismic Zones 3 & 4, IBC Seismic Zone D.
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 3. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 4. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
 - 5. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure; that are appropriate for substrate; and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to powder-actuated fasteners or drilled-in anchors that extend through forms into concrete.
 - 7. Do not attach hangers to steel deck tabs.
 - 8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 - 9. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; and provide hangers not more than 8 inches (200 mm) from ends of each member.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 - 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 - 2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3 mm in 3.6 m). Miter corners accurately and connect securely.
 - 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fitted accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
 - 1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.

- 2. Paint cut panel edges remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
- 3. Protect lighting fixtures and air ducts to comply with requirements indicated for fireresistance-rated assembly.

3.04. CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.
- 3.05. ACOUSTICAL PANEL CEILING SCHEDULE
 - A. Note locations and additional information as indicated on drawings and in Section 090000 "Finish Legend."
 - B. Ceiling Type C2: Acoustical panel, 2 x 2 lay-in, high NRC.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong Ultima Health Zone,
 - 2. ASTM Classification: Type IV, Form 2.
 - 3. Pattern Designation: E (lightly textured).
 - 4. Fire Resistance/Flame Spread: Class A (UL).
 - 5. Color: White.
 - 6. Light Reflectance Coefficient: Not less than 0.86
 - 7. Noise Reduction Coefficient: Not less than 0.80.
 - 8. Edge Detail: Square.
 - 9. Thickness: 1 inch.
 - 10. Size: 24 by 24 inches.
 - 11. Grid: 15/16 inch, with Axiom perimeter trim where offset edge is exposed.
 - 12. Thickness: 3/4 inch.
 - C. Suspension System: 15/16-inch grid.
 - 1. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, pre-painted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, G01 (Z001) coating designation, with prefinished 9/16-inch- narrow metal caps on flanges; other characteristics as follows:
 - a. Structural Classification: Heavy-duty system.
 - b. End Condition of Cross Runners: Override (stepped) or butt-edge type, as standard with manufacturer.
 - c. Face Design: Flush face.
 - d. Cap Material:
 - 1) General Areas: Steel sheet.
 - 2) Kitchen and Food Prep Areas: Hot dipped galvanized steel body with aluminum cap.
 - e. Cap Finish: Painted white.
 - f. Mounting method: With compression struts as indicated for seismic loading.
 - g. Edge Moldings: Hemmed edge, 2-inch edge angle per IBC 2003 requirements or combined with 1-inch edge angle and Armstrong BERC Clips or Chicago Metallic Seismic Retention Clip, concealed in framing members if acceptable to Building Authority.

SECTION 09 6500 RESILIENT FLOORING

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Resilient sheet flooring.
- B. Resilient base.
- C. Installation accessories.

1.02. RELATED REQUIREMENTS

A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

1.03. REFERENCE STANDARDS

- A. ASTM F1861 Standard Specification for Resilient Wall Base; 2008 (Reapproved 2012).
- B. RFCI (RWP) Recommended Work Practices for Removal of Resilient Floor Coverings; Resilient Floor Covering Institute; October 2011.

1.04. SUBMITTALS

- A. See Section 01 3000 Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Shop Drawings: Indicate seaming plans and floor patterns
- Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.
- E. Verification Samples: Submit two samples, 12 by 12 inch in size illustrating color and pattern for each resilient flooring product specified.
- F. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of sub-floor is acceptable.
- G. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

1.05. DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- D. Protect roll materials from damage by storing on end.
- E. Do not double stack pallets.

1.06. FIELD CONDITIONS

A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

2.01. SHEET FLOORING

- A. Vinyl Sheet Flooring: Color and pattern throughout wear layer thickness, with backing.
 - 1. Manufacturers: As indicated on Drawings.
 - 2. Total Thickness: 0.080 inch minimum.
 - 3. Heat welded seams.
 - 4. Integral coved base with cap strip where required on Drawings.
 - Height: As indicated on Drawings.
- B. Vinyl Welding Rod: Solid vinyl bead produced by manufacturer of vinyl flooring for heat welding seams, in color matching field color.

2.02. RESILIENT BASE

A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove.

- 1. Manufacturers: As indicated on Drawings.
- 2. Height: As indicated on Drawings.
- 3. Thickness: 0.125 inch thick.
- 4. Finish: Satin.
- 5. Length: Roll.
- Accessories: Premolded external corners.

2.03. ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Primers, Adhesives, and Seaming Materials: Waterproof; types recommended by flooring manufacturer.
 - 1. VOC Content Limits: As specified in Section 01 6116.
- C. Moldings, Transition and Edge Strips: Same material as flooring.
- D. Filler for Coved Base: Plastic.

PART 3 EXECUTION

3.01. EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

3.02. PREPARATION

- A. Remove existing resilient flooring and flooring adhesives; follow the recommendations of RFCI (RWP).
- B. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- C. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface. D. Prohibit traffic until filler is cured.

3.03. INSTALLATION

- A. Starting installation constitutes acceptance of sub-floor conditions.
- B. Install in accordance with manufacturer's instructions.
- C. Adhesive-Applied Installation:
 - 1. Spread only enough adhesive to permit installation of materials before initial set.
 - Fit joints and butt seams tightly.
 - 3. Set flooring in place, press with heavy roller to attain full adhesion.
- D. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- E. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
- F. Spread only enough adhesive to permit installation of materials before initial set.
- G. Fit joints tightly.
- H. Set flooring in place, press with heavy roller to attain full adhesion.
- I. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
- K. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.04. SHEET FLOORING

- A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns carefully at seams.
- B. Double cut sheet at seams.
- C. Lay flooring with tightly butted seams, without any seam sealer unless otherwise indicated.
- D. Coved Base: Install as detailed on drawings, using coved base filler as backing at floor to wall junction. Extend sheet flooring vertically to height indicated, and cover top edge with metal cap strip.

3.05. RESILIENT BASE

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 48 inches between joints and corner joints.
- B. Install base on solid backing. Bond tightly to wall and floor surfaces.
- C. Install base in a continuous bed of sealant at intersection of wall and floor.
- D. Scribe and fit to door frames and other interruptions.

3.06. CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's instructions.

3.07. PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

SECTION 09 6513 RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.01. RELATED DOCUMENTS

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

1.02. SUMMARY

- A. This Section includes the following:
 - Resilient wall base.
 - 2. Resilient carpet accessories.

1.03. SUBMITTALS

- A. Product Data: For each type of product specified.
- B. Samples for Initial Selection: Manufacturer's standard sample sets consisting of sections of units showing the full range of colors and patterns available for each type of product indicated
- C. Samples for Verification: In manufacturer's standard sizes, but not less than 12 inches (300 mm) long, of each product color and pattern specified.
- D. Product Certificates: Signed by manufacturers of resilient wall base and accessories certifying that each product furnished complies with requirements.

1.04. QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer to perform work of this Section who has specialized in installing resilient products similar to those required for this Project and with a record of successful in-service performance.
- B. Source Limitations: Obtain each type and color of product specified from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
- C. Adhesives and Sealants: For products applied on site and located inside the weatherproofing system, comply with the VOC content limits of Utah Administrative Code.
- D. Fire-Test-Response Characteristics: Provide products with the following fire-test-response characteristics as determined by testing identical products per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Critical Radiant Flux: 0.45 W/sq. cm or greater when tested per ASTM E 648.
 - 2. Smoke Density: Maximum specific optical density of 450 or less when tested per ASTM E 662.

1.05. DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to Project site in manufacturer's original, unopened cartons and containers, each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.
- B. Store products in dry spaces protected from the weather, with ambient temperatures maintained between 50 and 90 deg F (10 and 32 deg C).
- C. Move products into spaces where they will be installed at least 48 hours before installation, unless longer conditioning period is recommended in writing by manufacturer.

1.06. PROJECT CONDITIONS

- A. Maintain a temperature of not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C) in spaces to receive resilient products for at least 48 hours before installation, during installation, and for at least 48 hours after installation, unless manufacturer's written recommendations specify longer time periods. After post-installation period, maintain a temperature of not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- B. Do not install products until they are at the same temperature as the space where they are to be installed.

- C. For resilient products installed on traffic surfaces, close spaces to traffic during installation and for time period after installation recommended in writing by manufacturer.
- D. Coordinate resilient product installation with other construction to minimize possibility of damage and soiling during remainder of construction period. Install resilient products after other finishing operations, including painting, have been completed.

1.07. EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Furnish not less than 10 linear feet (3 linear m of each different type, color, pattern, and size of resilient product installed.
 - Deliver extra materials to Owner.

PART 2 - PRODUCTS

2.01. MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Project are limited to those shown on the Drawings and in the Finish Legend.

2.02. RESILIENT WALL BASE

A. Rubber Wall Base: Products complying with FS SS-W-40, Type I and with requirements specified in the Resilient Wall Base and Accessory Schedule at the end of this Section.

2.03. RESILIENT ACCESSORIES

A. Rubber Accessories: Products complying with requirements specified in the Resilient Wall Base and Accessory Schedule.

2.04. INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by resilient product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.01. EXAMINATION

A. Examine substrates, areas, and conditions where installation of resilient products will occur, with Installer present, for compliance with manufacturer's requirements, including those for maximum moisture content. Verify that substrates and conditions are satisfactory for resilient product installation and comply with requirements specified. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02. PREPARATION

- A. General: Comply with manufacturer's written installation instructions for preparing substrates indicated to receive resilient products.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- D. Broom and vacuum clean substrates to be covered immediately before installing resilient products. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.03. INSTALLATION

- General: Install resilient products according to manufacturer's written installation instructions.
- B. Apply resilient wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

- 1. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- 2. Do not stretch base during installation.
- 3. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
- 4. Install premolded outside corners before installing straight pieces.
- 5. Form inside corners on job, from straight pieces of maximum lengths possible, by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce a snug fit to substrate.
- D. Place resilient products so they are butted to adjacent materials and bond to substrates with adhesive. Install reducer strips at edges of flooring that would otherwise be exposed.

3.04. CLEANING AND PROTECTING

- A. Perform the following operations immediately after installing resilient products:
 - 1. Remove adhesive and other surface blemishes using cleaner recommended by resilient product manufacturers.
 - 2. Sweep or vacuum horizontal surfaces thoroughly.
 - 3. Do not wash resilient products until after time period recommended by resilient product manufacturer.
 - 4. Damp-mop or sponge resilient products to remove marks and soil.
- B. Protect resilient products against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by resilient product manufacturer.
 - 1. Cover resilient products installed on floors and stairs with undyed, untreated building paper until inspection for Substantial Completion.
- C. Clean resilient products not more than 4 days before dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project. Clean products according to manufacturer's written recommendations.
 - 1. Before cleaning, strip protective floor polish that was applied to vinyl products on floors and stairs after completing installation only if required to restore polish finish and if recommended by resilient product manufacturer.
 - 2. After cleaning, reapply polish on vinyl products on floors and stairs to restore protective floor finish according to resilient product manufacturer's written recommendations. Coordinate with Owner's maintenance program.

3.05. RESILIENT WALL BASE AND ACCESSORY SCHEDULE

- A. Rubber Wall Base:
 - 1. Color and Pattern: As indicated in Section 090000 "Finish Legend".
 - 2. Style and Location:
 - a. Style A, Straight: Provide in areas with carpet.
 - b. Style B, Cove: Provide in areas with hard-surface flooring.
 - 3. Minimum Thickness: 1/8 inch (3.2 mm).
 - 4. Height: 4 inches.
 - 5. Lengths: Coils in lengths standard with manufacturer, but not less than 96 feet (29.26 m).
 - 6. Outside Corners: Premolded.
 - 7. Inside Corners: Job formed.
 - 8. Ends: Premolded.9. Surface: Smooth.
 - **END OF SECTION**

SECTION 09 6516 RESILIENT SHEET FLOORING

PART 1 - GENERAL

1.01. RELATED DOCUMENTS

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

1.02. SUMMARY

- A. This Section includes sheet flooring with integral cove wall base.
- B. Related Sections include the following:
 - 1. Division 9 Section "Resilient Base and Accessories" for resilient wall base and flooring transition accessories.

1.03. SUBMITTALS

- A. Product Data: For each type of product specified.
- B. Shop Drawings: Show location of seams and edges. Indicate location of columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutout locations.
- C. Product Certificates: Signed by manufacturers of sheet floor coverings certifying that each product furnished complies with requirements.
- D. Maintenance Data: For sheet floor coverings to include in the maintenance manuals specified in Division 1.

1.04. QUALITY ASSURANCE

- A. Source Limitations: Obtain each type, color, and pattern of sheet floor covering specified from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
- B. Fire-Test-Response Characteristics: Provide products with the following fire-test-response characteristics as determined by testing identical products per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Critical Radiant Flux: 0.45 W/sq. cm or greater when tested per ASTM E 648.
 - 2. Smoke Density: Maximum specific optical density of 450 or less when tested per ASTM E 662.

1.05. DELIVERY, STORAGE, AND HANDLING

- A. Deliver sheet floor coverings and installation accessories to Project site in manufacturer's original, unopened cartons and containers, each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.
- B. Store products in dry spaces protected from the weather, with ambient temperatures maintained between 50 and 90 deg F (10 and 32 deg C). C. Store rolls upright.
- C. Move sheet floor coverings and installation accessories into spaces where they will be installed at least 48 hours before installation, unless longer conditioning periods are recommended in writing by manufacturer.

1.06. PROJECT CONDITIONS

- A. Maintain a temperature of not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C) in spaces to receive sheet floor coverings for at least 48 hours before installation, during installation, and for at least 48 hours after installation, unless manufacturer's written recommendations specify longer time periods. After post-installation period, maintain a temperature of not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- B. Do not install sheet floor coverings until they are at the same temperature as the space where they are to be installed.
- C. Close spaces to traffic during sheet floor covering installation and for time period after installation recommended in writing by manufacturer.
- Install sheet floor coverings and accessories after other finishing operations, including painting, have been completed.

- E. Where demountable partitions and other items are indicated for installation on top of sheet floor coverings, install floor coverings before these items are installed.
- F. Do not install sheet floor coverings over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive, as determined by floor covering manufacturer's recommended bond and moisture test.

PART 2 - PRODUCTS

- 2.01. SHEET FLOORING WITH INTEGRAL COVE WALL BASE
 - A. Basis-of-Design Product: Provide Mannington Commercial, BioSpec MD vinyl sheet flooring,
 - B. Product Standard: ASTM F 1913.
 - C. Thickness: 0.080 inch (2.0 mm).
 - D. Wearing Surface: Smooth.
 - E. Sheet Width: 6 feet (1.8 m).
 - F. Colors and Patterns: As indicated in Section 090000 "Finish Legend".

2.02. INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by floor covering manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit sheet floor covering and substrate conditions indicated.
 - 1. Adhesives shall have a VOC content of 50 g/L or less.
- C. Seamless-Installation Accessories:
 - 1. Heat-Weld Seaming: Manufacturer's standard solid or camouflaged weld rods.
 - 2. Chemical-Bonding Compound: Manufacturer's standard product for chemically bonding seams.
- D. Color: As selected by Architect from manufacturer's full range.
- E. Integral-Flash-Cove-Base Accessories:
 - 1. Cove Strip: 1-inch (25-mm) radius provided or approved by resilient sheet flooring manufacturer.
 - 2. Cap Strip: Square metal, vinyl, or rubber cap provided or approved by resilient sheet flooring manufacturer.
 - 3. Corners: Metal inside and outside corners and end stops provided or approved by resilient sheet flooring manufacturer.

PART 3 - EXECUTION

3.01. EXAMINATION

- A. Examine substrates, areas, and conditions where installation of sheet floor coverings will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for floor covering installation and comply with requirements specified.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
 - Slab substrates are dry and free of curing compounds, sealers, hardeners, and other
 materials that may interfere with adhesive bond. Determine adhesion and dryness
 characteristics by performing bond and moisture tests recommended by floor covering
 manufacturer.
 - 2. Subfloor finishes comply with requirements specified in Division 3 Section "Cast-in-Place Concrete" for slabs receiving resilient flooring.
 - 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

4.

C. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02. PREPARATION

- A. General: Comply with sheet floor covering manufacturer's written installation instructions for preparing substrates indicated to receive sheet vinyl floor coverings.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

- C. Remove coatings, including curing compounds, and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- D. Broom and vacuum clean substrates to be covered immediately before installing sheet floor coverings. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.03. INSTALLATION

- A. General: Comply with sheet floor covering manufacturer's written installation instructions.
- B. Unroll sheet floor coverings and allow them to stabilize before cutting and fitting, if recommended in writing by manufacturer.
- C. Lay out sheet floor coverings to comply with the following requirements:
 - 1. Maintain uniformity of sheet floor covering direction.
 - 2. Arrange for a minimum number of seams and place them in inconspicuous and low-traffic areas, and not less than 6 inches (150 mm) away from parallel joints in flooring substrates.
 - 3. Match edges of sheet floor coverings for color shading and pattern at seams according to manufacturer's written recommendations.
 - Avoid cross seams.
- D. Scribe, cut, and fit sheet floor coverings to butt neatly and tightly to vertical surfaces and permanent fixtures, including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.
- E. Extend sheet floor coverings into toe spaces, door reveals, closets, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other nonpermanent, non-staining marking device.
- G. Install sheet floor coverings on covers for telephone and electrical ducts, and similar items in finished floor areas. Maintain overall continuity of color and pattern with pieces of flooring installed on covers. Tightly adhere edges to perimeter of floor around covers and to covers.
- H. Adhere sheet floor coverings to flooring substrates to comply with floor covering manufacturer's written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.
 - 1. Produce completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- I. Seamless Installation:
 - 1. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and use welding bead to permanently fuse sections into a seamless floor covering. Prepare, weld, and finish seams to produce surfaces flush with adjoining floor covering surfaces.
 - 2. Chemically Bonded Seams: Bond seams with chemical-bonding compound to permanently fuse sections into a seamless flooring. Prepare seams and apply compound to produce tightly fitted seams without gaps, overlays, or excess bonding compound on flooring surfaces.
- J. Integral-Flash-Cove Base: Cove resilient sheet flooring 6 inches (152 mm) up vertical surfaces. Support flooring at horizontal and vertical junction with cove strip. Butt at top against cap strip.
- K. Hand roll sheet floor coverings in both directions from center out to embed floor coverings in adhesive and eliminate trapped air. At walls, door casings, and other locations where access by roller is impractical, press floor coverings firmly in place with flat-bladed instrument.

3.04. CLEANING AND PROTECTING

- A. Perform the following operations immediately after installing sheet vinyl floor coverings:
 - 1. Remove adhesive and other surface blemishes using cleaner recommended by floor covering manufacturer.
 - 2. Sweep or vacuum floor thoroughly.

- Do not wash floor covering until after time period recommended by floor covering manufacturer.
- 4. Damp-mop floor to remove marks and soil.
- B. Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by floor covering manufacturer.
 - 1. Apply protective floor polish to sheet floor covering surfaces that are free from soil, visible adhesive, and surface blemishes, if recommended in writing by manufacturer.
 - a. Use commercially available product acceptable to floor covering manufacturer.
 - b. Coordinate selection of floor polish with Owner's maintenance service.
 - 2. Cover sheet floor coverings with undyed, untreated building paper until inspection for Substantial Completion.
 - 3. Do not move heavy and sharp objects directly over sheet floor coverings. Place plywood or hardboard panels over floor coverings and under objects while they are being moved. Slide or roll objects over panels without moving panels.
- C. Clean sheet floor coverings not more than 4 days before dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project. Clean floor coverings according to manufacturer's written recommendations.
 - 1. Before cleaning, strip protective floor polish that was applied after completing installation only if required to restore polish finish and if recommended by floor covering manufacturer.
 - 2. After cleaning, reapply polish to floor surfaces to restore protective floor finish according to floor covering manufacturer's written recommendations. Coordinate with Owner's maintenance program.

Sherwin Williams Contractor Job Tracking Form

To be included in Contractor Bid Package

Instructions for Contractor:

- Please complete this form with as much information as available
- If you have an assigned Sherwin Williams Sales Representative or a Home store that services, your account please contact them directly with this form
- If you do not have a Sherwin Williams assigned account manager, please email this form to Michael.J.Koncilja@Sherwin.com
- This form must be forwarded to Sherwin Williams prior to the start of any Capital Expenditure Project
- A job account must be assigned for every project

Instructions for Sherwin Williams Employees:

- Upon receiving this form please open a job account for the paint contractor
- The job account must read as follows: Intermountain Healthcare/Name of City/ Project Name
- A job account is strictly required for all IHC related projects
- Upon opening an IHC job account, an email containing the 9 digit job account number is to be sent to <u>Michael.J.Koncilja@Sherwin.com</u> for tracking purposes
- A request for this project to be linked to Parent #5540 will be communicated
- All Purchases associated with said project are to be made on this job account only

Project Tracking Form

Name of Contractor:
Sherwin Williams Account number (Existing):
IHC Job Account number (To be assigned):
Name and Address of IHC related Project:
Name/Store of Sherwin Williams Contact:
Estimated Materials Needed:
Estimated Project Start Date:
Additional Comments/Needs of Contractor: (I.E renderings needed, drawdowns required, Special environmental restrictions.)

SECTION 09 9123 INTERIOR PAINTING

PART 1 - GENERAL

- 1.01. RELATED DOCUMENTS
 - A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- 1.02. SUMMARY
 - A. This Section includes surface preparation and field painting that includes, but is not limited to, the following:
 - 1. Doors and frames.
 - 2. Interior gypsum board assemblies.
 - 3. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
 - B. Low VOC coatings complying with Utah Administrative Code R307-361 are required as work of this Section. Low Odor for Owners requirements
 - C. Related Sections include the following:
 - 1. Division 7 Section "Joint Sealers" for sealing open joints in new construction.
 - 2. Division 8 Section "Steel Doors and Frames" for shop priming steel doors and frames.
 - 3. Division 9 Section "Gypsum Board Assemblies" for surface preparation for gypsum board.
 - D. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate color or finish, the Architect will select from standard colors and finishes available.
 - Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment. Include painting of exposed radial duct.
 - 2. Interior Painting includes application of joint sealants to all joints created by new construction, including, but not limited to, edges of counters, door frames to walls, joints between plumbing fixtures and walls, countertops to walls etc.
 - E. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
 - 1. Prefinished items include the following factory-finished components:
 - a. Architectural woodwork and casework.
 - b. Finished mechanical and electrical equipment.
 - c. Light fixtures.
 - d. Distribution cabinets.
 - 2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
 - a. Furred areas.
 - b. Ceiling plenums.
 - c. Pipe spaces.
 - d. Duct shafts.
 - 3. Finished metal surfaces include the following:
 - a. Anodized aluminum.
 - b. Stainless steel.
 - c. Chromium plate.
 - 4. Operating parts include moving parts of operating equipment and the following:
 - a. Valve and damper operators.
 - b. Linkages.

- c. Sensing devices.
- d. Motor and fan shafts.
- 5. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

1.03. DEFINITIONS

- A. General: Standard coating terms defined in ASTM D 16 apply to this Section.
 - 1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
 - 2. Eggshell refers to low-sheen finish with a gloss range between 5 and 20 when measured at a 60-degree meter.
 - 3. Satin refers to low-sheen finish with a gloss range between 15 and 35 when measured at a 60-degree meter.
 - 4. Semigloss refers to medium-sheen finish with a gloss range between 30 and 65 when measured at a 60-degree meter.
 - 5. Full gloss refers to high-sheen finish with a gloss range more than 65 when measured at a 60-degree meter.

1.04. SUBMITTALS

- A. Product Data: For each paint system specified. Include block fillers and primers.
 - 1. Material List: Provide an inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 - 2. Manufacturer's Information: Provide manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
 - 3. Certification by the manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).
- B. Samples for Verification: Of each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.
 - 1. Provide stepped Samples, defining each separate coat, including primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
 - 2. Provide a list of materials and applications for each coat of each sample. Label each sample for location and application.
 - a. Submit Samples for Architect's review of color and texture only
- C. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.05. QUALITY ASSURANCE

- A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to that indicated for this Project with a record of successful in-service performance.
- B. Source Limitations: Obtain primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.
- C. VOC Content: Utah Administrative Code R307-361. Products shall comply with VOC limits of authorities having jurisdiction and, for interior and exterior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 1. Flat Paints and Coatings: 50 g/L.
 - 2. Nonflat Paints and Coatings: 100 g/L.
 - 3. Dry-Fog Coatings: 150 g/L.
 - 4. Primers, Sealers, and Undercoaters: 100 g/L.

- 5. Industrial maintenance Coatings Applied to Ferrous Metals: 250 g/L.
- 6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
- 7. Pretreatment Wash Primers: 420 g/L.
- 8. Floor Coatings Foot Traffic: 100 g/L.
- 9. Floor Coatings High Performance: 250 g/L.
- 10. Shellacs, Clear: 730 g/L.
- 11. Shellacs, Pigmented: 550 g/L.
- 12. Wood Coatings: 275 g/L

1.06. DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:
 - Product name or title of material.
 - 2. Product description (generic classification or binder type).
 - 3. Manufacturer's stock number and date of manufacture.
 - 4. Contents by volume, for pigment and vehicle constituents.
 - 5. Thinning instructions.
 - 6. Application instructions.
 - 7. Color name and number.
 - VOC content.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain containers used in storage in a clean condition, free of foreign materials and residue.
 - 1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.07. PROJECT CONDITIONS

- A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 and 90 deg F (10 and 32 deg C).
- B. Do not apply when the relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
 - 1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

1.08. EXTRA MATERIALS

- A. Furnish extra paint materials from the same production run as the materials applied in the quantities described below. Package paint materials in unopened, factory-sealed containers for storage and identify with labels describing contents. Deliver extra materials to the Owner.
 - Quantity: Furnish the Owner with extra paint materials in the quantities indicated below:
 - a. Interior, Low-Luster Acrylic Finish: 1 gals of each color applied.
 - b. Interior, Semigloss Acrylic Enamel: 2 gal. (7.57 L) of each color applied.

PART 2 - PRODUCTS

2.01. MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in the paint schedules as a standard of quality for the work
- B. Manufacturers Names to comply with Owners Standards: The following manufacturers provide products that may be incorporated into the Work
 - 1. Benjamin Moore

2.02. PAINT MATERIALS, GENERAL

A. Material Compatibility: Provide block fillers, primers, undercoats, and finish-coat materials that are compatible with one another and the substrates indicated under conditions of

- service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Material Quality: Provide manufacturer's best-quality premium paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
 - Proprietary Names: Use of manufacturer's proprietary product names to designate
 colors or materials is not intended to imply that products named are required to be used
 to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's
 material data and certificates of performance for proposed substitutions. C. Colors:
 Provide color selections made by the Architect.

PART 3 - EXECUTION

3.01. EXAMINATION

- A. Examine substrates, areas, and conditions, with the Applicator present, under which painting will be performed for compliance with paint application requirements.
 - 1. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 - 2. Verify that all sealants have been applied in locations that abut areas to be painted.
 - 3. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
 - 1. Notify the Architect about anticipated problems using the materials specified over substrates primed by others.

3.02. PREPARATION

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- B. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning.
 - 1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
 - 1. Provide barrier coats over incompatible primers or remove and reprime.
 - 2. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations.
 - a. Blast steel surfaces clean as recommended by paint system manufacturer and according to requirements of SSPC-SP 10.
 - b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
 - c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.
- D. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.

- Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
- 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
- 3. Use only thinners approved by paint manufacturer and only within recommended limits.
- E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.03. APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
 - 1. Paint colors, surface treatments, and finishes are indicated in the schedules.
 - 2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 - 3. Provide finish coats that are compatible with primers used.
 - 4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
 - 5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
 - 7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 - 8. Sand lightly between each succeeding enamel or varnish coat.
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
 - The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 - 2. Omit primer on metal surfaces that have been shop primed and touchup painted.
 - 3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 - 4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.
- C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
 - 1. Brushes: Use brushes best suited for the type of material applied. Use brush of appropriate size for the surface or item being painted.
 - 2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.

- 3. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for the material and texture required.
- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.
- E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and in occupied spaces.
- F. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.
- G. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- H. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.
- I. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.04. FIELD QUALITY CONTROL

- A. The Owner reserves the right to invoke the following test procedure at any time and as often as the Owner deems necessary during the period when paint is being applied:
 - 1. The Owner will engage the services of an independent testing agency to sample the paint material being used. Samples of material delivered to the Project will be taken, identified, sealed, and certified in the presence of the Contractor.
 - 2. The testing agency will perform appropriate tests for the following characteristics as required by the Owner:
 - a. Quantitative material analysis.
 - b. Abrasion resistance.
 - c. Apparent reflectivity.
 - d. Flexibility.
 - e. Washability.
 - f. Absorption.
 - g. Accelerated weathering.
 - h. Dry opacity.
 - i. Accelerated yellowness.
 - j. Recoating.
 - k. Skinning.
 - I. Color retention.
 - m. Alkali and mildew resistance.
 - 3. The Owner may direct the Contractor to stop painting if test results show material being used does not comply with specified requirements. The Contractor shall remove noncomplying paint from the site, pay for testing, and repaint surfaces previously coated with the rejected paint. If necessary, the Contractor may be required to remove rejected paint from previously painted surfaces if, on repainting with specified paint, the 2 coatings are incompatible.

3.05. CLEANING

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.

1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

3.06. PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect
- B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
- C. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.07. PAINTING SCHEDULES

- A. Design Standards are used to establish a level of quality for the work. Premium products equal in quality, of the other named manufacturers may be used. The use of a Design Standard is not to be construed as a limit of competition or a constraint of trade.
- B. Design Standard are based upon products by Benjamin Moore (Owners standard)

3.08. INTERIOR PAINT SCHEDULE

- A. Ferrous Metal, Semi-Gloss Finish: 2 latex finish coats over shop-applied primer (MPI INT 5.1X).
 - 1. Shop-Applied Primer: For items not shop-primed, the finish coat product is self-priming, so will be used for the primer as well as the finish coats.
 - 2. Two Finish Coats: Super Spec HP D.T.M. Acrylic Semi-Gloss #P29.
- B. Gypsum Board (Walls), Eggshell Finish: 2 latex finish coats over primer.
 - 1. Shop-Applied Primer: Ultra Spec 500 Interior Latex Primer #N534 (MPI listed Product, Categories 50, 50-X, 149, 149-X).
 - 2. Two Finish Coats: Ultra Spec 500 Interior Eggshell Finish N538 (MPI Listed Product Categories 52, 52-X Green).
- C. Gypsum Board (Ceilings), Low-Sheen Finish (Gloss Level 2): 2 latex finish coats over primer.
 - 1. Shop-Applied Primer: Ultra Spec 500 Interior Latex Primer #N534 (MPI listed Product, Categories 50, 50-X, 149, 149-X).
 - 2. Two Finish Coats: Ultra Spec 500 Interior Low Sheen Finish N537 (MPI Listed Product, Categories 44, 44-X Green).
- D. Gypsum Board (Toilet Room Walls and Ceilings): 2-component epoxy waterborne system 2 finish coats over a primer, MPI INT 9.2F.
 - 1. Prime Coat: MPI #50, Interior Latex Primer Sealer.
 - 2. Two Finish Coats: Epoxy, MPI #115, Interior/Exterior Epoxy (water based).

SECTION 10 2123 PRIVACY CURTAINS

PART 1 - GENERAL

- 1.01. RELATED DOCUMENTS
 - A. Drawings and general provisions of the Contract apply to this Section.
- 1.02. SUMMARY
 - A. This Section includes the following:
 - 1. Cubicle curtains and track.
- 1.03. PERFORMANCE REQUIREMENTS
 - A. Curtains: Provide curtain fabrics with the following characteristics:
 - 1. Fabrics are launderable to a temperature of not less than 160 deg F (71 deg C).
 - 2. Fabrics are flame resistant and are identical to those that have passed NFPA 701 when tested by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - Identify fabrics with appropriate markings of applicable testing and inspecting agency.

1.04. SUBMITTALS

- A. Product Data: Include durability, fade resistance, and fire-test-response characteristics for each type of curtain fabric indicated.
 - 1. Include data on each type of applied curtain treatment.
- B. Shop Drawings: Show sizes of curtains and number of grommets.
- C. Samples for Initial Selection: For each type of curtain fabric indicated.

1.05. PROJECT CONDITIONS

A. Environmental Limitations: Do not install cubicle curtains until adjacent work is complete.

PART 2 - PRODUCTS

2.01. MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide products of one of the following:
 - 1. ADC Hospital Equipment; Division of Automatic Devices Company.
 - 2. Alderman Acres Mfg, Inc.
 - 3. Barjan Manufacturing Ltd.
 - 4. Coldraco, Inc.
 - 5. Covoc Corporation.
 - 6. Crowder, K. N. Manufacturing, Inc.
 - 7. Cubicle Curtain Factory, Inc.
 - 8. Diamond Drapery Co.
 - 9. General Cubicle Company, Inc.
 - 10. Imperial Fastener Company, Inc.
 - 11. InPro Corporation.
 - 12. Nelson, A. R. Co.
 - 13. Pryor Products.
 - 14. Salsbury Industries.
 - 15. Silent Gliss USA Inc.
 - 16. Tubular Specialties Manufacturing, Inc.

2.02. CURTAIN TRACKS

- A. Extruded-Aluminum Track: Not less than 1-1/4 inches wide by 3/4 inch high (32 mm wide by 19 mm high) with minimum wall thickness of 0.050 inch (1.27 mm).
 - 1. Finish: Clear anodized.
- B. Track Accessories: Fabricate end caps, connectors, end stops, coupling and joining sleeves, wall flanges, brackets, ceiling clips, and other accessories from same material and with same finish as track.
 - 1. End Stop: Nonremovable.

- C. Curtain Carriers: Two nylon rollers and nylon axle with aluminum hook.D. Exposed Fasteners: Stainless steel.

2.03. **CURTAINS**

- A. Curtain Fabric:
 - 1. Color: As selected by Architect.
 - Fiber Content: 100 percent polyester, inherently and permanently flame resistant, stain resistant, and anti-microbial.
- B. Curtain Grommets: Two-piece, rolled-edge, rustproof, nickel-plated brass; spaced not more than 6 inches (152 mm) o.c.; machined into top hem.

2.04. **CURTAIN FABRICATION**

- A. Fabricate curtains to comply with the following requirements:
 - Width: Equal to headrail length from which curtain is hung plus 10 percent added fullness, but not less than 12 inches (305 mm) added fullness.
 - Length: Equal to floor-to-headrail height, minus 4 inches at top for suspended carriers, 12 inches at top for open mesh fabric and minus 12 inch distance above finished floor at bottom.
 - Mesh Top: Top hem of mesh not less than 1 inch (25.4 mm) and not more than 1-1/2 inches (38 mm) wide, triple thickness, reinforced with integral web, and double lock stitched. Double lockstitch bottom of mesh directly to 1/2-inch (13-mm) triple thickness, top hem of curtain fabric
 - Bottom Hem: Not less than 1 inch (25.4 mm) and not more than 1-1/2 inches (38 mm) wide, double thickness and double lock stitched.
 - Side Hems: Not less than 1/2 inch (12.7 mm) and not more than 1-1/4 inches (31.8 mm) wide, with double turned edges, and single lock stitched.
 - Vertical Seams: Not less than 1/2 inch (12.7 mm) wide, double turned and double stitched.

PART 3 - EXECUTION

EXAMINATION 3.01.

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of work.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02. **INSTALLATION**

- A. General: Install tracks level and plumb, according to manufacturer's written instructions.
- B. Provide track fabricated from one continuous length.
 - Curtain Track Mounting: Surface.
- C. Surface Track Mounting: Fasten surface-mounted tracks at intervals of not less than 24 inches (610 mm). Fasten support at each splice and tangent point of each corner. Center fasteners in track to ensure unencumbered carrier operation. Attach track to ceiling as follows:
 - Mechanically fasten directly to finished ceiling with toggle bolts where gypsum board ceilings are used.
 - Attach track to suspended ceiling grid with manufacturer's proprietary clip.
- D. Track Accessories: Install splices, end caps, connectors, end stops, coupling and joining sleeves, and other accessories as required for a secure and operational installation.
- E. Curtain Carriers: Provide curtain carriers adequate for 6-inch (152-mm) spacing along full length of curtain plus an additional carrier.
- F. Curtains: Hang curtains on each curtain track. Secure with curtain tieback.

INSTALLATION 3.03.

A. Curtains: Hang curtains on each curtain headrail.

SECTION 10 2600 WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.01. RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General Scope Requirements and Division 1 Specification Sections, apply to this Section.

1.02. SUMMARY

- A. This Section includes the following
 - 1. Corner guards to be installed at outside corners of partitions in all areas.
 - 2. Impact-resistant wall coverings.
- B. Related Sections include the following:
 - Division 6 Section "Rough Carpentry" for wood blocking for surface-mounted corner guards.

1.03. SUBMITTALS

- A. Product Data: Include physical characteristics, for each impact-resistant wall protection system component indicated.
- B. Shop Drawings: Show locations, extent, and installation details of each impact-resistant wall protection system component. Show methods of attachment to adjoining construction.
- C. Samples for Initial Selection: For each type of impact-resistant wall protection unit indicated.
- D. Samples for Verification: For the following products, showing the full range of color and texture variations expected in each impact-resistant wall protection system component. Prepare Samples from the same material to be used for the Work.
 - 1. Wall and Corner Guards: 12-inch- (300-mm-) long Samples of each type of impactresistant wall protection system component required. Include examples of joinery, corners, and field splices.
 - 2. Impact-Resistant Wall Covering: 6 by 6 inches (150 by 150 mm) square.
- E. Maintenance Data: For each impact-resistant wall protection system component to include in maintenance manuals specified in Division 1.

1.04. QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed installation of impactresistant wall protection system components 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. Manufacturer Qualifications: A firm experienced in manufacturing impact-resistant wall protection system components similar to those required for this Project and with a record of successful in-service performance.
- C. Composite wood, agrifiber products, and adhesives shall not contain urea-formaldehyde resin
- D. Source Limitations: Obtain impact-resistant wall protection system component from a single source with resources to provide components of consistent quality in appearance and physical properties.
- E. Product Options: Drawings indicate size, profiles, and dimensional requirements of impact-resistant wall protection system and are based on the specific system indicated. Other manufacturers systems with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architects approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- F. Surface-Burning Characteristics: Provide impact-resistant, plastic wall protection units with surface-burning characteristics as determined by testing identical products per ASTM E 84, NFPA 255, or UL 723 by UL or another qualified testing agency.

G. Impact Strength: Provide impact-resistant wall protection system components with a minimum impact resistance of 25.4 ft-lbf/in. (1356 J/m) of width when tested according to ASTM D 256, Test Method A.

1.05. DELIVERY, STORAGE, AND HANDLING

- A. Store wall surface-protection materials in original undamaged packages and containers inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
 - 1. Maintain room temperature within the storage area at not less than 70 deg F (21 deg C) during the period plastic materials are stored. Keep sheet material out of direct sunlight to avoid surface distortion.

1.06. PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install impact-resistant wall protection units until building is enclosed and weatherproof, wet work is complete and dry, and HVAC system is operating and maintaining temperature at 70 deg F (21 deg C) for not less than 72 hours before beginning installation and for the remainder of the construction period.

1.07. WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall protection units that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Deterioration of plastic and other materials beyond normal use.
- B. Warranty Period: Five years from date of Substantial Completion.

1.08. EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Corner-Guard Covers: Full-size plastic covers of maximum length equal to 2 percent of each type, color, and texture of units installed, but no fewer than two, 4-foot- (1.2-m-) long units.
- B. Include mounting and accessory components. Replacement materials shall be from same production run as installed units.

PART 2 - PRODUCTS

2.01. MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide impact-resistant wall protection system products by one of the following:
 - 1. Arden Architectural Specialties, Inc.
 - 2. Balco. Inc.
 - 3. Construction Specialties.
 - 4. IPC Door and Wall Protection Systems, Inc.
 - 5. Pawling corporation
 - 6. Wilkinson Company, Inc.

2.02. MATERIALS

- A. PVC-Free Thermoplastic: Class 1, chemical- and stain-resistant, high-impact-resistant PVCfree thermoplastic with integral color throughout; extruded and sheet material, thickness as indicated. Thermoplastic with no PBT's (persistent bioacccumulative toxins), BPA (bisphenol A) or halogenated fire-retardants.
 - 1. Impact Resistance: Minimum 25.4 ft-lbf/in. (1356 J/m) of notch when tested according to ASTM D 256, Test Method A.
 - Chemical and Stain Resistance: Tested according to ASTM D 1308.
 - 3. Self-extinguishing when tested according to ASTM D 635.
 - 4. Flame-Spread Index: 25 or less.
 - 5. Smoke-Developed Index: 450 or less.

- B. PETG (PVC-Free) Rigid Sheet: Class A/1, abrasion resistant; with a minimum impactresistance rating of 13 ft.-lbs./in. when tested according to ASTM D 256.
- C. Aluminum Extrusions: Alloy and temper recommended by manufacturer for type of use and finish indicated, but with not less than strength and durability properties specified in ASTM B 221 (ASTM B 221M) for Alloy 6063-T5.
- D. Stainless-Steel Plate: Type 304, minimum 0.0625 inch (1.6 mm).
- E. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.
- F. Adhesive: As recommended by impact-resistant plastic wall protection manufacturer and with a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.03. CORNER GUARDS

- A. Surface-Mounted, Resilient, Plastic Corner Guards: Assembly consisting of snap-on plastic cover installed over continuous retainer; including mounting hardware; fabricated with 90- or 135-degree turn to match wall condition.
 - Basis-of-Design Product: Subject to compliance with requirements, provide Construction Specialties Acrovyn 4000 Model SSM-20N or comparable product by one of the following:
 - a. American Floor Products Co., Inc.
 - b. Arden Architectural Specialties, Inc.
 - c. Balco, Inc.
 - d. Construction Specialties, Inc.
 - e. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - f. Musson Rubber Company.
 - g. Pawling Corporation.
 - h. Tepromark International, Inc.
 - i. WallGuard.com.
 - 2. Cover: Extruded rigid plastic, minimum 0.078-inch (2.0-mm) thickness; as follows:
 - a. Profile: Nominal 2-inch- (50-mm-) long leg and 1/4-inch (6-mm) corner radius.
 - b. Height: As indicated.
 - c. Color and Texture: As indicated.
 - 3. Retainer: Minimum 0.060-inch- (1.5-mm-) thick, one-piece, extruded aluminum.
 - 4. Retainer Clips: Manufacturer's standard impact-absorbing clips.
 - 5. Top and Bottom Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.
- B. Stainless-Steel Corner Guards (Food Service Areas): Paper-covered, satin-finish, 0.0625-inch (1.6-mm) minimum, stainless-steel sheet corner guards. Provide 90-degree turn, unless otherwise indicated; and formed edges.
 - 1. Wing Size: 3-1/2 by 3-1/2 inches.
 - 2. Height: As indicated.
 - 3. Mounting Method: Flat-head, countersunk screws through factory-drilled mounting holes.
 - 4. Corner Radius: 1/8 inch (3.2 mm).

2.04. IMPACT-RESISTANT WALL COVERINGS

- A. Impact-Resistant Sheet Wall Covering: Fabricated from plastic sheet wall-covering material.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Construction Specialties Acrovyn 4000 0.060-inch Rigid Sheet or comparable product by one of the following:
 - a. American Floor Products Co., Inc.
 - b. Arden Architectural Specialties, Inc.
 - c. Balco, Inc.
 - d. Construction Specialties, Inc.

- e. IPC Door and Wall Protection Systems; Division of InPro Corporation.
- f. Kwalu, LLC.
- g. Pawling Corporation.
- h. Tepromark International, Inc.
- i. WallGuard.com.
- 2. Size: 48 by 96 inches (1219 by 2438 mm) for sheet.
- 3. Sheet Thickness: 0.060 inch (1.5 mm).
- 4. Color and Texture: As indicated.
- 5. Height: As indicated.
- 6. Trim and Joint Moldings: Extruded rigid plastic that matches sheet wall covering color.
- 7. Mounting: Adhesive.

2.05. FABRICATION

- A. General: Fabricate impact-resistant wall protection systems to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including thicknesses of components.
- B. Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.
- C. Fabricate components with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.06. FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary covering before shipping.
- C. 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.

2.07. STAINLESS-STEEL FINISHES

- A. Satin, Directional Polish: No. 4 or No. 6 finish as standard with manufacturer
 - 1. Remove tool and die marks and stretch lines or blend into finish.
 - 2. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

PART 3 - EXECUTION

3.01. EXAMINATION

- A. Examine areas and conditions in which impact-resistant wall protection system components will be installed.
 - 1. Complete finishing operations, including painting, before installing impact-resistant wall protection system components.
- B. Examine walls to which impact-resistant wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
 - For impact-resistant wall protection units attached with adhesive or foam tape, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02. PREPARATION

A. General: Before installation, clean substrate to remove dust, debris, and loose particles.

3.03. INSTALLATION

A. Install impact-resistant wall protection system components level, plumb, and true to line without distortions.

- 1. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- B. Install retainers, mounting brackets, and other accessories according to the manufacturer's written instructions.

3.04. CLEANING

- A. General: Immediately on completion of installation, clean metal components according to the manufacturer's written instructions.
- B. Remove surplus materials, rubbish, and debris, resulting from installation, on completion of work and leave installation areas in neat, clean condition.

SECTION 10 2800 TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.01. RELATED DOCUMENTS

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

1.02. SUMMARY

- A. This Section includes the following:
 - 1. Toilet and bath accessories.
 - 2. Under-lavatory guards.
- B. Related Sections include the following:
 - 1. Division 10 Section "Toilet Compartments" for compartments and screens.

1.03. SUBMITTALS

- A. Product Data: Include construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.
- B. Samples: For each accessory item to verify design, operation, and finish requirements.
 - 1. Approved full-size Samples will be returned and may be used in the Work.
- C. Setting Drawings: For cutouts required in other work; include templates, substrate preparation instructions, and directions for preparing cutouts and installing anchoring devices.
- D. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required. Use designations indicated on Drawings in product schedule.
- E. Maintenance Data: For accessories to include in maintenance manuals specified in Division1. Provide lists of replacement parts and service recommendations.

1.04. QUALITY ASSURANCE

- A. Source Limitations: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise approved by Architect.
 - 1. Products of other manufacturers listed in Part 2 with equal characteristics, as judged solely by Architect, may be provided.
- B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent

1.05. COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by disabled persons, proper installation, adjustment, operation, cleaning, and servicing of accessories.

1.06. WARRANTY

- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01. MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering accessories that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Toilet Accessories:
 - a. A & J Washroom Accessories. Inc.
 - b. American Specialties, Inc.
 - c. Bobrick Washroom Equipment, Inc.
 - d. Bradley Corporation.

- e. General Accessory Manufacturing Co. (GAMCO).
- f. McKinney/Parker Washroom Accessories Corp.

2.02. MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, with No. 4 finish (satin), in 0.0312-inch (0.8-mm) minimum nominal thickness, unless otherwise indicated.
- B. Brass: ASTM B 19, leaded and unleaded flat products; ASTM B 16 (ASTM B 16M), rods, shapes, forgings, and flat products with finished edges; ASTM B 30, castings.
- C. Sheet Steel: ASTM A 366/A 366M, cold rolled, commercial quality, 0.0359-inch (0.9-mm) minimum nominal thickness; surface preparation and metal pretreatment as required for applied finish.
- D. Galvanized Steel Sheet: ASTM A 653/A 653M, G60 (Z180).
- E. Chromium Plating: ASTM B 456, Service Condition Number SC 2 (moderate service), nickel plus chromium electrodeposited on base metal.
- F. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- G. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.

2.03. FABRICATION

- A. General: Logos are not permitted on exposed face of accessories. On interior surface not exposed to view or back surface of each accessory, provide printed, waterproof label or stamped nameplate indicating manufacturer's name and product model number.
- B. Surface-Mounted Toilet Accessories: Unless otherwise indicated, fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with continuous stainless-steel hinge. Provide concealed anchorage where possible.
- C. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.01. INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Secure mirrors to walls in concealed, tamper-resistant manner with special hangers, toggle bolts, or screws. Set units level, plumb, and square at locations indicated, according to manufacturer's written instructions for substrate indicated.
- C. Install grab bars to withstand a downward load of at least 250 lbf (1112 N), when tested according to method in ASTM F 446.

3.02. ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

3.03. TOILET ACCESSORY SCHEDULE

- A. Basis-of-Design Products: Provide products from Bobrick Trimline Series, unless otherwise noted, or similar products of acceptable manufacturers listed in Part 2 of this section.
- B. Soap Dispenser, Counter-Mount: Bobrick B-822 Soap Dispenser. Corrosion resistant dispenser with vandal-resistant locking cover and free-turning spout. Body and shank of highimpact-resistant ABS plastic with shatter-resistant polyethylene container. Capacity: 34 fluid ounces. Spout length: 4 inches. Mounting thickness: 4 inches. Spout finish: bright polished.
- C. Soap Dispenser, Wall-Mount: Bobrick B-26607 TrimLine Series Surface-Mounted Liquid Soap Dispenser. Accepts liquid soap cartridges or bulk-fill soaps. Push-activated with less than 5 lbs. of force. Capacity: 17 fluid ounces. Concealed wall fastening. Hinged housing

- with key lock and soap refill window. Size: 3-3/4 inches wide x 11-3/4 inches high x 6 inches deep. Finish: Satin-finish stainless steel.
- D. Grab Bar: Where this designation is indicated, provide stainless-steel grab bars complying with the following:
 - 1. Stainless-Steel Nominal Thickness: Minimum 0.05 inch (1.3 mm).
 - 2. Mounting: Concealed with manufacturer's standard flanges and anchors.
 - 3. Gripping Surfaces: Smooth, satin finish.
 - 4. Outside Diameter: 1-1/2 inches (38 mm) for heavy-duty applications.
 - 5. 30. 36 and 42 inch Horizontal Bars and 18 inch Vertical Bar: Bobrick B6806.
- E. Anti-Suicide Grab Bar: Where this designation is indicated, provide stainless-steel grab bars complying with the following:
 - 1. Security grab bar with a closure plate between the rail and the mounting surface that precludes the draping or wrapping of items around the bar. With concealed mounting system and fastened to a tenon plate with set screws.
- F. Seat-Cover Dispensers: Bobrick B-3013 TrimLine Series Recessed Seat-Cover Dispenser. Satin-finish stainless steel. Door has 90 degree return that conceals flange. Capacity: 500 toilet seat covers. Rough wall opening: 15-5/8 inches wide x 11-1/4 inches high x 2-3/4 inches minimum depth.
- G. Sanitary Napkin Disposal Unit, Surface-Mounted: Bobrick B-254 Surface Mounted Sanitary Napkin Disposal. Cabinet fabricated of type 304 heavy-gauge stainless steel. Contains leakproof, rigid molded polyethylene waste receptacle with 1.2-gallon capacity. Size: 10-11/16 inches wide x 15-1/8 inches high x 4-1/16 inches deep.
- H. Sanitary Vendor: Bobrick B-37063 50 TrimLine Series Recessed Napkin / Tampon Vendor.
 - 1. Size: 13-7/8 inches wide x 28 inches high.
 - 2. Type: Sanitary napkin and tampon.
 - 3. Mounting: Recessed mounted.
 - 4. Operation: One or two quarters.
 - 5. Capacity: 30 tampons, 20 napkins.
 - 6. Material and Finish: Type 304 stain-finish stainless steel on exposed surfaces. 7.
- I. Mirror Unit:
 - 1. Products: Bobrick B-292 sizes as noted.
 - 2. Stainless-Steel, Angle-Framed Mirror: Fabricate frame from stainless-steel angles in manufacturer's standard satin finish with square corners welded, ground and polished smooth.
 - a. With type 304 satin-finish stainless steel shelf projecting 5 inches with ¾-inch return on front and sides; front return edge hemmed for rigidity and safety; corners welded, ground and polished smooth.
- J. Shower Curtains and Track: Break-Away Type, held in place using safety tabs ("hook-and-loop" attachment system) which attach to back of curtains; fluid proof, permanently flame resistant, tear resistant, self-deodorizing and self-sanitizing linen finish fabric.
 - 1. Basis-of-Design Product: Imperial Fastener Co., IFC-69 Jiffy Aperture, Break-A-Way Tab System for ceiling mounting with "Staph-Chek" shower curtain; or approved equal.
- K. Diaper Changing Station:
 - 1. Basis-of-Design Product: Koala Kare KB-110-SSRE Recessed-Mounted Stainless Steel Finish Baby Changing Station.
- L. 2. Description: Fully recessed horizontal unit with stainless steel exterior finish that opens by folding down from stored position and with child-protection strap.
 - a. Engineered to support a minimum of 250-lb (113-kg) static load when opened.
 - b. Mounting: Recessed-mounted.
 - c. Operation: By pneumatic shock-absorbing mechanism.
 - Material and Finish: High-density polyethylene in manufacturer's standard gray color.

- e. Liner Dispenser: Built in.
- f. Rough Wall Opening Size: 35-1/2 inches wide x 20-1/2 inches high x 4-1/4 inches minimum deep.
- M. Mop and Broom Holder: At all Janitor Closets with sinks, provide mop and broom holder complying with the following:
 - 1. Products: Bobrick B-239, 34" long.
 - 2. Mop and Broom Holder: 34-inch- (914-mm-) long unit fabricated of minimum nominal 0.0375-inch- (0.95-mm-) thick, stainless-steel hat channel with four stainless steel hooks and three anti-slip spring-loaded, rubber, cam-type, mop/broom holders.
- N. Robe Hook: Bobrick B-6827 Surface-Mounted Hat and Coat Hook. Type 304 satin-finish stainless steel. Mounting bracket concealed by 2-inch square flange with support arm. Oneinch wide x 6-1/2 inch high 12-gauge stainless steel hook welded to support arm. Hook extends 3-1/16 inches from wall.
- O. Toilet Tissue Dispenser: Owner-furnished and contractor-installed.
- P. Paper Towel Dispenser: Owner-furnished and contractor-installed.
- Q. Sharps Container, Wall-Mounted: Owner-furnished and contractor-installed.

SECTION 10 4413 FIRE-PROTECTION SPECIALTIES

PART 1 - GENERAL

1.01. RELATED DOCUMENTS

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

1.02. SUMMARY

- A. This Section includes the following:
 - 1. Portable fire extinguishers.
 - 2. Fire-protection cabinets for portable fire extinguishers. Rated and non-rated

1.03. SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection specialties.
 - 1. Fire Extinguishers: Include rating and classification.
 - 2. Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
- 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 cabinet finish indicated.
- C. Samples for Verification: For each type of exposed cabinet finish required, prepared on Samples of size indicated below and of same thickness and material indicated for the Work. If finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
 - 1. Size: 6-by-6-inch- (150-by-150-mm-) square Samples.

1.04. QUALITY ASSURANCE

- A. Source Limitations: Obtain fire extinguishers and cabinets through one source from a single manufacturer.
- B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Standard for Portable Fire Extinguishers."
- C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
 - 1. Provide extinguishers listed and labeled by FM.

1.05. COORDINATION

A. Coordinate size of cabinets to ensure that type and capacity of fire extinguishers indicated and provided by Owner under separate Contract are accommodated.

PART 2 - PRODUCTS

2.01. MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Portable Fire Extinguishers:
 - a. Amerex Corporation.
 - b. J.L. Industries, Inc.
 - c. Kidde: Walter Kidde, The Fire Extinguisher Co.
 - d. Larsen's Manufacturing Company.
 - e. Potter-Roemer; Div. of Smith Industries, Inc.
 - 2. Fire-Protection Cabinets:
 - a. J.L. Industries. Inc.
 - b. Larsen's Manufacturing Company.
 - c. Potter-Roemer; Div. of Smith Industries, Inc.

2.02. MATERIALS

- A. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
 - 1. Sheet: ASTM B 209 (ASTM B 209M).

2.03. PORTABLE FIRE EXTINGUISHERS

- A. General: Provide fire extinguishers of type, size, and capacity for each cabinet and other locations indicated.
- B. Multipurpose Dry-Chemical Type: UL-rated 4-A:60-B:C, 10-lb (4.5-kg) nominal capacity, in enameled-steel container.

2.04. FIRE-PROTECTION CABINETS

- A. Cabinet Construction: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld joints and grind smooth. Miter and weld perimeter door frames.
 - Cabinet Metal: Aluminum sheet.
 - 2. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.0428-inch- (1.1-mm-) thick, cold-rolled steel sheet lined with minimum 5/8-inch-(16mm-) thick, fire-barrier material. Provide factory-drilled mounting holes.
- B. Cabinet Type: Suitable for the following:
 - 1. Fire extinguisher.
- C. Cabinet Mounting: Suitable for the following mounting conditions: as scheduled or shown on drawings
 - Semi-recessed: Cabinet box partially recessed in walls of shallow depth to suit style of trim indicated.
- D. Cabinet Trim Style: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.
 - 1. Exposed Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
 - Rolled-Edge Trim: 2-1/2-inch (64-mm) backbend depth.
- E. Cabinet Trim Material: Manufacturer's standard, as follows:
 - 1. Aluminum sheet.
- F. Door Material: Manufacturer's standard, as follows:
 - 1. Aluminum sheet.
- G. Glazing: Impact resistant as standard with manufacturer.
 - Glass: Clear float glass, ASTM C 1036, Type I, Class 1, Quality q3, 1.5 mm, single strength.
- H. Door Style: Manufacturer's standard design, as follows:
 - Vertical duo panel with frame. Lockable with pressure release latch.
- Door Construction: Fabricate doors according to manufacturer's standards, of materials indicated, and coordinated with cabinet types and trim styles selected.
 - Provide minimum 1/2-inch- (13-mm-) thick door frames, fabricated with tubular stiles and rails, and hollow-metal design.
 - Provide inside latch and lock that releases under pressure
- Door Hardware: Provide manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide either lever handle with cam-action latch, or exposed or concealed door pull and friction latch. Provide concealed or continuous-type hinge permitting door to open 180 degrees.

2.05. **ACCESSORIES**

- A. Door Locks: Provide cylinder lock, with all cabinets keyed alike.
- Identification: Provide lettering to comply with authorities having jurisdiction for letter style, color, size, spacing, and location. Locate as indicated by Architect.
 - Identify fire extinguisher in cabinet with the words "FIRE EXTINGUISHER" applied to
 - Application Process: Vinyl letters. a.

- b. Lettering Color: Red.
- c. Orientation: Vertical.
- C. Mounting Brackets: For kitchen application provide Manufacturer's standard galvanized steel, bracket designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish. Red color unless otherwise indicated.

2.06. FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: 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.
- D. Cabinet and Door Finishes: Provide manufacturer's standard baked-enamel paint for Interior of cabinets and doors.

2.07. ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: non-specular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 607.1.

PART 3 - EXECUTION

3.01. EXAMINATION

- A. Examine roughing-in for cabinets to verify actual locations of piping connections before cabinet installation.
- B. Examine walls and partitions for suitable framing depth and blocking where semi-recessed cabinets are to be installed.
- C. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged units.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02. INSTALLATION

- A. Comply with manufacturer's written instructions for installing fire-protection specialties.
- B. Install in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
 - 1. Prepare recesses for cabinets as required by type and size of cabinet and trim style.
 - 2. Fasten cabinets to structure, square and plumb.

3.03. ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust cabinet doors that do not swing or operate freely.
- B. Refinish or replace cabinets and doors damaged during installation.
- C. Provide final protection and maintain conditions that ensure that cabinets and doors are without damage or deterioration at the time of Substantial Completion.

SECTION 21 1000

WATER-BASED FIRE-SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following fire-suppression piping inside the building:
 - 1. Wet-pipe sprinkler systems.
 - 2. Description:
- B. Related Sections include the following:
 - 1. Division 10 Section "Fire Extinguisher Cabinets" and "Fire Extinguishers" for cabinets and fire extinguishers.
 - 2. Division 22 Section "Facility Water Distribution Piping" for piping outside the building.
 - 3. Division 28 Section "Fire Detection and Alarm" for alarm devices not specified in this Section.
- C. All black steel sprinkler pipe shall have a wall thickness less than or equal to schedule 40 and greater than schedule 10.
 - 1. Exception: Pipe with a nominal pipe size of 6 inches and greater may be schedule 10.

D. Summary Table:

Item	Summary
Underground service entrance piping	Existing to remain.
Interior pipe type	Mains: Schedule 40 Branchlines: Threadable thinwall or schedule 40
Sprinkler Finish	Flat Plate Concealed, except uprights and storage
Extended Coverage	Not Allowed
Center of Tile	Required, Center thirds are acceptable for rectangular tiles
Flexible Sprinkler Drops	Designers preference
FM Global	No
Calculations	Not required.
Alarm Device	Horn/Strobe
FDC	Existing to remain.
Special Items	

Seismic

1.3 DEFINITIONS

- A. CPVC: Chlorinated polyvinyl chloride plastic.
- B. CR: Chlorosulfonated polyethylene synthetic rubber.
- C. High-Pressure Piping System: Fire-suppression piping system designed to operate at working pressure higher than standard 175 psig.
- D. PE: Polyethylene plastic.
- E. Underground Service-Entrance Piping: Underground service piping below the building.

1.4 SYSTEM DESCRIPTIONS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.5 PERFORMANCE REQUIREMENTS

- A. Standard Piping System Component Working Pressure: Listed for at least 175 psig.
- B. High-Pressure Piping System Component Working Pressure: Listed for 250 psig minimum 300 psig.
- C. Fire-suppression standpipe system design shall be approved by authorities having jurisdiction.
 - 1. Minimum residual pressure at each hose-connection outlet is the following:
 - a. NPS 1-1/2 Hose Connections: 65 psig.
 - b. NPS 2-1/2 Hose Connections: 100 psig.
 - 2. Unless otherwise indicated, the following is maximum residual pressure at required flow at each hose-connection outlet:
 - a. NPS 1-1/2 Hose Connections: 100 psig.
 - b. NPS 2-1/2 Hose Connections: 175 psig.
- D. Design sprinkler piping and obtain approval from engineer, prior to submitting to other authorities having jurisdiction:
 - 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 - 2. Sprinkler Occupancy Hazard Classifications:

- a. Automobile Parking Areas: Ordinary Hazard, Group 1.
- b. Building Service Areas: Ordinary Hazard, Group 1.
- c. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
- d. General Storage Areas: Ordinary Hazard, Group 1.
- e. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
- f. Office and Public Areas: Light Hazard.
- g. Residential Living Areas: Light Hazard.
- h. Restaurant Service Areas: Ordinary Hazard, Group 1.
- 3. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
- b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
- c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
- d. Special Occupancy Hazard: As determined by authorities having jurisdiction.
- 4. Minimum Density for Deluge-Sprinkler Piping Design:
- a. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over entire area.
- b. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over entire area.
- c. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over entire area.
- d. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over entire area.
- e. Special Occupancy Hazard: As determined by authorities having jurisdiction.
- 5. Maximum Protection Area per Sprinkler: Per UL listing.
- 6. 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: According to NFPA 13 recommendations, unless otherwise indicated.
- 7. Total Combined Hose-Stream Demand Requirement: According to 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.
- 8. Sprinklers are to be installed throughout the premises, as required by NFPA 13.
- E. Seismic Performance: Fire-suppression piping shall be capable of withstanding the effects of earthquake motions determined according to NFPA 13.

1.6 SUBMITTALS

- A. Product Data: For the following:
 - 1. Piping materials, including dielectric fittings, flexible connections, and sprinkler specialty fittings.
 - 2. Pipe hangers and supports, including seismic restraints.
 - 3. Valves, including listed fire-protection valves, unlisted general-duty valves, and specialty valves and trim.
 - 4. Air compressors, including electrical data.

- 5. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.
- 6. Hose connections, including size, type, and finish.
- 7. Fire department connections, including type; number, size, and arrangement of inlets; caps and chains; size and direction of outlet; escutcheon and marking; and finish.
- 8. Alarm devices, including electrical data.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Fire-hydrant flow test report.
- D. Seismic Calculations.
- E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations, if applicable. Drawings are to be approved by Engineer prior to submission to State Fire Marshal.
- F. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13 and NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."
- G. Welding certificates.
- H. Field quality-control test reports.
- I. Operation and Maintenance Data: For standpipe and sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. An experienced installer who has designed and installed fire-suppression piping similar to that indicated for this Project and obtained design approval and inspection approval from authorities having jurisdiction. The Engineer requires evidence to support the ability of the contractor to perform work in the scope and volume as specified. A contractor, who cannot show such experience, may be found not suitable to perform the work. The following are the approved contractors for this project:
 - a. PRE-APPROVED CONTRACTORS LIST
 - 1) A&D Fire
 - 2) Alta Fire
 - 3) Certified Fire
 - 4) Chaparral Fire (A-1 National)
 - 5) Delta Fire
 - 6) Kimco Fire
 - 7) Preferred Fire Protection
 - 8) Quality Fire Protection
 - 9) FireTrol
 - 10) FireFly Fire Protection
 - 11) Simplex-Grinnell
 - 12) State Fire DC Specialties

- 13) The Safety Team
- 14) Western Automatic
- 15) Or prior approved equal
- b. A contractor not listed in the "PRE-APPROVED CONTRACTORS LIST" must receive prior approval from the engineer to bid this project.
- B. 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.
 - 1. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer or NICET Level III technician.
- C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
- D. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:
 - 1. NFPA 13, "Installation of Sprinkler Systems."
 - 2. NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height."
 - 3. NFPA 14, "Installation of Standpipe, Private Hydrant, and Hose Systems."
 - 4. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."
- E. International Conference of Building Code Officials codes and standards complying with the following:
 - 1. IBC-2018, "International Building Code."
 - 2. IFC-2018, "International Fire Code."
- F. Utah Amendments
 - 1. Title 15A

1.8 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Sprinkler Cabinets: Finished, wall-mounting, steel cabinet with hinged cover, with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include a minimum of six spare sprinklers for each type and rating of sprinkler head in the project per CMS and CDC requirement. The minimum number of sprinklers per NFPA 13 shall be required regardless of how many head types there are. There is no upper limit of spare sprinklers. Include separate cabinet with sprinklers and wrench for each type of sprinkler on Project.

1.10 General Engineering Quality

- A. Unless noted otherwise the following applies:
 - 1. The maximum water velocity shall not exceed 32-fps.
 - 2. Submit the calculations using the reduced flow data.
 - 3. When calculating flexible drops, the contractor shall use the maximum number of bends for the associated length. The value is to be taken from the UL tests (unless the material is only FM approved).
 - 4. In the event of multiple (3) submittal rejections (including revise and resubmit) a meeting shall be held at the engineer's office at the engineer time of choosing and the designer, fire sprinkler contractor, and general contractor shall be physically in attendance to discuss the required modifications to the design.

1.11 Contract Completion

- A. Incomplete and Unacceptable work:
 - 1. If additional site visits or design work is required by the Engineer or Architect because of the use of incomplete or unacceptable work by the Contractor, then the Contractor shall reimburse the Engineer and Architect for all additional time and expenses involved.

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 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell end and plain end.
 - 1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, Class 53, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron gland, rubber gasket, and steel bolts and nuts.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell end and plain end.
 - 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - 2. Gaskets: AWWA C111, rubber.

2.3 C-900 TUBE AND FITTINGS

A. PVC, AWWA Pipe: AWWA C900, Class 150, with bell end with gasket and spigot end.

- 1. Comply with UL 1285 for fire-service mains if indicated.
- 2. PVC Fabricated Fittings: AWWA C900, Class 150, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
- 3. PVC Molded Fittings: AWWA C907, Class 150, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
- 4. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 - a. Gaskets: AWWA C111, rubber.
- 5. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
- a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.4 STAINLESS STEEL IN BUILDING RISER

- A. Continuous from the factory, no field formed fittings in the stainless steel riser. Field modifications are not allowed. Restrain with thrust block, per NFPA 24, rods as required by manufacture.
 - Inlet: AWWA C900/DIP
 Outlet: AWWA 606

2.5 STEEL PIPE AND FITTINGS

- A. Threaded-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where indicated and with factory- or field-formed threaded ends.
 - 1. Cast-Iron Threaded Flanges: ASME B16.1.
 - 2. Malleable-Iron Threaded Fittings: ASME B16.3.
 - 3. Gray-Iron Threaded Fittings: ASME B16.4.
 - 4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe hot-dip galvanized where indicated. Include ends matching joining method.
 - 5. Steel Threaded Couplings: ASTM A 865 hot-dip galvanized-steel pipe where indicated.
- B. Plain-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795 hot-dip galvanized-steel pipe where indicated.
 - 1. Locking-Lug Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn to secure pipe in fitting not allowed.
- C. Plain-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795 hot-dip galvanized-steel pipe where indicated.
 - 1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
 - 2. Steel Flanges and Flanged Fittings: ASME B16.5.

- D. Grooved-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where indicated and with factory- or field-formed, roll-grooved ends.
 - 1. Grooved-Joint Piping Systems:
 - a. Manufacturers:
 - 1) Anvil International, Inc.
 - 2) Bull Moose Tube, Inc.
 - 3) Central Sprinkler Corp.
 - 4) Victaulic Co. of America.
 - 5) Ward Manufacturing.
 - 6) Wheatland Tube
 - b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
 - c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, prelubricated rubber gasket listed for use with housing, and steel bolts and nuts.
- E. Threaded-End, Threadable, Thinwall Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and greater than Schedule 10, and with factory- or field-formed threaded ends.
 - 1. Cast-Iron Threaded Flanges: ASME B16.1.
 - 2. Malleable-Iron Threaded Fittings: ASME B16.3.
 - 3. Gray-Iron Threaded Fittings: ASME B16.4.
 - 4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe.
 - 5. Steel Threaded Couplings: ASTM A 865.
- F. Plain-End, Threadable, Thinwall Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and greater than Schedule 10.
 - 1. Locking-Lug Fittings: UL 213, ductile-iron body with retainer lugs that require onequarter turn to secure pipe in fitting not allowed.
- G. Plain-End, Threadable, Thinwall Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and greater than Schedule 10.
 - 1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
 - 2. Steel Flanges and Flanged Fittings: ASME B16.5.
- H. Grooved-End, Threadable, Thinwall Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and greater than Schedule 10, and with factory- or fieldformed, roll-grooved ends.
 - 1. Grooved-Joint Piping Systems:
 - a. Manufacturers:
 - 1) Anvil International, Inc.
 - 2) Bull Moose Tube. Inc.

- 3) Central Sprinkler Corp.
- 4) Victaulic Co. of America.
- 5) Ward Manufacturing.
- 6) Wheatland Tube
- b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
- c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, prelubricated rubber gasket listed for use with housing, and steel bolts and nuts.
- I. Plain-End, Schedule 10 Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 is not allowed.
- J. Plain-End, Nonstandard OD, Thinwall Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 10 is not allowed.
- K. Plain-End, Hybrid Steel Pipe: ASTM A 135 or ASTM A 795, lightwall, with wall thickness less than Schedule 10 and greater than Schedule 5 is not allowed.
- L. Grooved-End, Hybrid Steel Pipe: ASTM A 135 or ASTM A 795, lightwall, with wall thickness less than Schedule 10 and greater than Schedule 5; with factory- or field-formed, roll-grooved ends are not allowed.
- M. Schedule 5 Steel Pipe: ASTM A 135 or ASTM A 795, lightwall, with plain ends is not allowed.

2.6 CPVC TUBE AND FITTINGS

A. CPVC is not allowed on this project.

2.7 FLEXIBLE SPRINKLER DROPS

- A. Flexible connectors shall be FM approved with exterior wire braid and have materials suitable for system fluid. Include 175-psig minimum working-pressure rating and ends according to the following:
 - 1. NPS 1: Threaded.
- B. Manufacturers:
 - 1. Flex-Head
 - 2. Victaulic
- C. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.
- D. Stainless-Steel-Hose/Stainless-Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to hose.

2.8 FLEXIBLE PIPE CONNECTORS (SEISMIC)

- A. Flexible connectors shall be FM approved with exterior wire braid and have materials suitable for system fluid. Include 175-psig minimum working-pressure rating and ends according to the following:
 - 1. NPS 2 and Smaller: Threaded.
 - 2. NPS 2-1/2 and Larger: Flanged.
 - 3. Option for NPS 2-1/2 and Larger: Grooved for use with grooved-end-pipe couplings.

B. Manufacturers:

- 1. Flexicraft Industries.
- 2. Flex-Pression, Ltd.
- 3. Metraflex, Inc.
- C. Bronze-Hose, Flexible Connectors: Corrugated, bronze, inner tubing covered with bronze wire braid. Include copper-tube ends or bronze flanged ends, braze welded to hose.
- D. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.
- E. Stainless-Steel-Hose/Stainless-Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to hose.

2.9 CORROSION-PROTECTIVE ENCASEMENT FOR PIPING

A. Encasement for Underground Metal Piping: ASTM A 674 or AWWA C105, PE film, 0.008-inch minimum thickness, tube or sheet.

2.10 SPRINKLER SPECIALTY FITTINGS

- A. Sprinkler specialty fittings shall be FMG approved with 175-psig minimum working-pressure rating, and made of materials compatible with piping. Sprinkler specialty fittings shall have 250psig minimum working-pressure rating if fittings are components of high-pressure piping systems.
- B. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body, with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.
 - Manufactures:
 - a. Central Sprinkler Corp.
 - b. Fire-End and Croker Corp.
 - c. Viking Corp.
 - d. Victaulic Co. of America.
- C. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.

- D. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.
- E. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.
- F. Dry-Pipe-System Fittings: UL listed for dry-pipe service.

2.11 LISTED FIRE-PROTECTION VALVES

- A. Valves shall be FMG approved, with 175-psig minimum pressure rating. Valves shall have 250-psig minimum pressure rating if valves are components of high-pressure piping system.
- B. Gate Valves with Wall Indicator Posts:
 - 1. Gate Valves: UL 262, cast-iron body, bronze mounted, with solid disc, nonrising stem, operating nut, and flanged ends.
 - 2. Indicator Posts: UL 789, horizontal-wall type, cast-iron body, with hand wheel, extension rod, locking device, and cast-iron barrel.
 - 3. Manufacturers:
 - a. Grinnell Fire Protection.
 - b. McWane, Inc.; Kennedy Valve Div.
 - c. NIBCO.
 - d. Stockham.
- C. Ball Valves: Comply with UL 1091, except with ball instead of disc.
 - 1. NPS 1-1/2 and Smaller: Bronze body with threaded ends.
 - 2. NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
 - 3. NPS 3: Ductile-iron body with grooved ends.
 - 4. Manufacturers:
 - a. NIBCO.
 - b. Victaulic Co. of America.
- D. Butterfly Valves: UL 1091.
 - 1. NPS 2 and Smaller: Bronze body with threaded ends.
 - a. Manufacturers:
 - 1) Global Safety Products, Inc.
 - 2) Milwaukee Valve Company.
 - 2. NPS 2-1/2 and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with flanged or grooved ends.
 - a. Manufacturers:
 - 1) Central Sprinkler Corp.
 - 2) McWane, Inc.; Kennedy Valve Div.
 - 3) Mueller Company.
 - 4) NIBCO.

- 5) Victaulic Co. of America.
- E. Check Valves NPS 2 and Larger: UL 312, swing type, cast-iron body with flanged or grooved ends.
 - 1. Manufacturers:
 - a. American Cast Iron Pipe Co.; Waterous Co.
 - b. Central Sprinkler Corp.
 - c. Clow Valve Co.
 - d. Crane Co.; Crane Valve Group; Crane Valves.
 - e. Crane Co.; Crane Valve Group; Jenkins Valves.
 - f. Fivalco
 - g. Globe Fire Sprinkler Corporation.
 - h. Grinnell Fire Protection.
 - i. Hammond Valve.
 - j. McWane, Inc.; Kennedy Valve Div.
 - k. Mueller Company.
 - I. NIBCO.
 - m. Potter-Roemer; Fire Protection Div.
 - n. Reliable Automatic Sprinkler Co., Inc.
 - o. Star Sprinkler Inc.
 - p. Stockham.
 - q. United Brass Works, Inc.
 - r. Victaulic Co. of America.
 - s. Watts Industries, Inc.; Water Products Div.
- F. Gate Valves: UL 262, OS&Y type.
 - 1. NPS 2 and Smaller: Bronze body with threaded ends.
 - a. Manufacturers:
 - 1) Crane Co.; Crane Valve Group; Crane Valves.
 - 2) Fivalco.
 - 3) Hammond Valve.
 - 4) NIBCO.
 - 5) United Brass Works, Inc.
 - 2. NPS 2-1/2 and Larger: Cast-iron body with flanged ends.
 - a. Manufacturers:
 - 1) Clow Valve Co.
 - 2) Crane Co.; Crane Valve Group; Crane Valves.
 - 3) Crane Co.; Crane Valve Group; Jenkins Valves.
 - 4) Fivalco
 - 5) Hammond Valve.
 - 6) Milwaukee Valve Company.
 - 7) Mueller Company.
 - 8) NIBCO.
 - 9) United Brass Works, Inc.
- G. Indicating Valves: UL 1091, with integral indicating device and ends matching connecting piping.

- 1. Indicator: Electrical, 115-V ac, prewired, single-circuit, supervisory switch and Visual.
- 2. NPS 2 and Smaller: Ball or butterfly valve with bronze body and threaded ends.
 - a. Manufacturers:
 - 1) Milwaukee Valve Company.
 - NIBCO.
 - 3) Victaulic Co. of America.
- 3. NPS 2-1/2 and Larger: Butterfly valve with cast- or ductile-iron body; wafer type or with flanged or grooved ends.
- a. Manufacturers:
 - 1) Central Sprinkler Corp.
 - 2) Grinnell Fire Protection.
 - 3) McWane, Inc.; Kennedy Valve Div.
 - 4) Milwaukee Valve Company.
 - 5) NIBCO.
 - 6) Victaulic Co. of America.
- H. Supervised Normally Closed Valve
 - 1. Indicator: Electrical, 115-V ac, prewired, single-circuit, supervisory switch and visual to send signal on partial close.
 - a. Manufactures:
 - 1) NIBCO.
 - 2) Victaulic Co. of America.

2.12 UNLISTED GENERAL-DUTY VALVES

- A. Ball Valves NPS 2 and Smaller: MSS SP-110, 2-piece copper-alloy body with chrome-plated brass ball, 600-psig minimum CWP rating, blowout-proof stem, and threaded ends.
- B. Check Valves NPS 2 and Smaller: MSS SP-80, Type 4, Class 125 minimum, swing type with bronze body, nonmetallic disc, and threaded ends.
- C. Gate Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, solid wedge, and threaded ends.
- D. Globe Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, nonmetallic disc, and threaded ends.

2.13 SPECIALTY VALVES

- A. Sprinkler System Control Valves: FMG approved, cast- or ductile-iron body with flanged or grooved ends, and 175-psig minimum pressure rating. Control valves shall have 250-psig minimum pressure rating if valves are components of high-pressure piping system.
 - 1. Manufacturers:

- a. Globe Fire Sprinkler Corporation.
- b. Reliable Automatic Sprinkler Co., Inc.
- c. Victaulic Co. of America.
- d. Viking Corp.

2.14 SPRINKLERS

- A. Sprinklers shall be UL listed or FMG approved, with 175-psig minimum pressure rating. Sprinklers shall have 250-psig minimum 300-psig pressure rating if sprinklers are components of high-pressure piping system.
- B. Sprinklers shall have 250-psig minimum 300-psig pressure rating if sprinklers are components of high-pressure piping system.
- C. Manufacturers:
 - 1. Globe Fire Sprinkler Corporation.
 - 2. Reliable Automatic Sprinkler Co., Inc.
 - 3. Victaulic Co. of America.
 - 4. Viking Corp.
 - 5. Tyco Fire
- D. Automatic Sprinklers: With heat-responsive element complying with the following:
 - 1. UL 199, for nonresidential applications.
 - 2. UL 1626, for residential applications.
- E. Sprinkler Types and Categories: Nominal 1/2-inch orifice for "Ordinary" temperature classification rating, unless otherwise indicated or required by application.
 - 1. Open Sprinklers: UL 199, without heat-responsive element.
 - a. Orifice: 1/2 inch, with discharge coefficient K between 5.3 and 5.8.
 - b. Orifice: 17/32 inch, with discharge coefficient K between 7.4 and 8.2.
- F. Sprinkler types, features, and options as follows:
 - 1. Concealed ceiling sprinklers, including cover plate.
 - 2. Extended-coverage sprinklers, not allowed unless approved in writing prior to bidding.
 - 3. Flow-control sprinklers, with automatic open and shutoff feature.
 - 4. Flush ceiling sprinklers, including escutcheon, not allowed.
 - 5. Institution sprinklers, made with a small, breakaway projection.
 - 6. Pendent sprinklers.
 - 7. Pendent, dry-type sprinklers.
 - 8. Quick-response sprinklers.
 - 9. Sidewall sprinklers.
 - 10. Sidewall, dry-type sprinklers.
 - 11. Upright sprinklers.
- G. Sprinkler Finishes: Chrome plated, bronze, and painted. Finishes as approved by FM Global.
- H. Special Coatings: Wax, lead, and corrosion-resistant paint.

- I. 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: Flat plate concealed, white.
 - 2. Sidewall Mounting: Flat plate concealed, white.
- J. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

2.15 HOSE CONNECTIONS

- A. Manufacturers:
 - 1. Central Sprinkler Corp.
 - 2. Elkhart Brass Mfg. Co., Inc.
 - 3. Fire-End and Croker Corp.
 - 4. Fivalco
 - 5. Grinnell Fire Protection.
 - 6. Guardian Fire Equipment Incorporated.
 - 7. McWane, Inc.; Kennedy Valve Div.
 - 8. Mueller Company.
 - 9. Potter-Roemer; Fire-Protection Div.
 - 10. United Brass Works, Inc.
- B. Description: UL 668, brass or bronze, 300-psig minimum pressure rating, hose valve for connecting fire hose. Include angle or gate pattern design; female NPS inlet and male hose outlet; and lugged cap, gasket, and chain. Include NPS 1-1/2 or NPS 2-1/2, and hose valve threads according to NFPA 1963 and matching local fire department threads.
 - 1. Valve Operation: Nonadjustable type, unless pressure-regulating type is indicated.
 - 2. Finish: Rough metal.

2.16 FIRE DEPARTMENT CONNECTIONS

A. Existing to remain.

2.17 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Electrically Operated Alarm: UL 464, with 8-inch- minimum- diameter, vibrating-type, metal alarm bell with red-enamel factory finish and suitable for outdoor use.
 - 1. Manufacturers:
 - Potter Electric Signal Company.
 - b. System Sensor.
- C. Electrically Operated Alarm: Horn/Strobe, NEMA 3R minimum suitable for outdoor use.
 - 1. Manufacturers:

- a. Potter Electric Signal Company.
- System Sensor.
- D. Water-Flow Indicator: UL 346, electrical-supervision, paddle-operated-type, water-flow detector with 250-psig pressure rating and designed for horizontal or vertical installation. Include two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
 - 1. Manufacturers:
 - a. ADT Security Services, Inc.
 - b. Grinnell Fire Protection.
 - c. ITT McDonnell & Miller.
 - d. Potter Electric Signal Company.
 - e. System Sensor.
 - f. Viking Corp.
 - g. Watts Industries, Inc.; Water Products Div.
- E. Pressure Switch: UL 753, electrical-supervision-type, water-flow switch with retard feature. Include single-pole, double-throw, normally closed contacts and design that operates on rising pressure and signals water flow.
 - 1. Manufacturers:
 - a. Grinnell Fire Protection.
 - b. Potter Electric Signal Company.
 - c. System Sensor.
 - d. Viking Corp.
- F. Valve Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled valve is in other than fully open position.
 - 1. Manufacturers:
 - a. McWane, Inc.; Kennedy Valve Div.
 - b. Potter Electric Signal Company.
 - c. System Sensor.
- G. Indicator-Post Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled indicator-post valve is in other than fully open position.
 - 1. Manufacturers:
 - a. Potter Electric Signal Company.
 - b. System Sensor.
- 2.18 PRESSURE GAGES
 - A. Manufacturers:
 - 1. Brecco Corporation.

- 2. Dresser Equipment Group; Instrument Div.
- 3. Marsh Bellofram.
- 4. WIKA Instrument Corporation.
- B. Description: UL 393, 3-1/2- to 4-1/2-inch- diameter, dial pressure gage with range of 0 to 250 psig minimum.
 - 1. Water System Piping: Include caption "WATER" or "AIR/WATER" on dial face.
 - 2. Air System Piping: Include retard feature and caption "AIR" or "AIR/WATER" on dial face.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 EXAMINATION

- A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.
- B. Examine walls and partitions for suitable thicknesses, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PIPING APPLICATIONS

- A. Shop weld pipe joints where welded piping is indicated.
- B. Do not use welded joints for galvanized-steel pipe.
- C. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.
- D. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
- E. Underground Service-Entrance Piping: Ductile-iron, push-on or mechanical-joint pipe and fittings and restrained joints. Include corrosion-protective encasement.
- F. Sprinkler Main Piping: Use the following:
 - 1. NPS 6 and Smaller: Standard-weight steel pipe with threaded ends, or grooved ends. No plain ends allowed.
 - 2. Outlets shall be welded.

- a. Victaulic Brand Mechanical tee fittings may be used in lieu of welded outlets.
- G. Branch line piping: Use the following:
 - 1. NPS 1-1/4 and Smaller: Threadable steel pipe with threaded ends; cast- or malleable-iron threaded fittings; and threaded joints.
 - a. Victaulic Brand Mechanical tee fittings may be used
- H. Standpipes and mains: Use the following:
 - 1. NPS 4 to NPS 6: Schedule 40 steel pipe with grooved ends & Welded outlets.
 - 2. NPS 3 and Smaller: Schedule 40 steel pipe with threaded ends, or grooved ends. No plain ends allowed.

3.4 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Fire-Protection-Service Valves: UL listed and FM approved for applications where required by NFPA 13 and NFPA 14.
 - 2. General-Duty Valves: For applications where UL-listed and FM-approved valves are not required by NFPA 13 and NFPA 14.
 - a. Shutoff Duty: Use gate, ball, or butterfly valves.
 - b. Throttling Duty: Use globe, ball, or butterfly valves.

3.5 JOINT CONSTRUCTION

- A. Refer to Division 23 Section "Common Work Result for HVAC" for basic piping joint construction.
- B. Ductile-Iron-Piping, Grooved Joints: Use ductile-iron pipe with radius-cut-grooved ends; ductile-iron, grooved-end fittings; and ductile-iron, keyed couplings. Assemble joints with couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.
- C. Steel-Piping, Grooved Joints: Use Schedule 40 steel pipe with cut or roll-grooved ends and Schedule 30 or thinner steel pipe with roll-grooved ends; steel, grooved-end fittings; and steel, keyed couplings. Assemble joints with couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions. Use gaskets listed for dry-pipe service for dry piping.

3.6 WATER-SUPPLY CONNECTION

A. Install shutoff Backflow preventions assemblies, valve, pressure gage's, drain, and other accessories at connection to water service.

3.7 PIPING INSTALLATION

- A. Refer to Division 23 Section "Common Work Result for HVAC" for basic piping installation.
- B. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- C. Install underground service-entrance piping according to NFPA 24 and with restrained joints.
- D. Make connections between underground and above-ground piping using bolted flange.
- E. Install mechanical sleeve seal at pipe penetrations in basement and foundation walls. Refer to Division 23 Section "Common Work Result for HVAC."
- F. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- G. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.
- H. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.
- Install "Inspector's Test Connections" in sprinkler piping, complete with shutoff valve, sized and located according to NFPA 13.
- J. Install sprinkler piping with drains for complete system drainage.
- K. Install sprinkler zone control valves, check valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- L. Install drain valves on standpipes.
- M. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.
- N. Install alarm devices in piping systems.
- O. Hangers and Supports: Comply with NFPA 13 for hanger materials. Install according to NFPA 13 for sprinkler piping and to NFPA 14 for standpipes.
 - 1. No powder driven studs allowed.
 - 2. Wrap-around braces are to be provided at end of branch lines.
- P. Earthquake Protection: Install piping according to NFPA 13-9.3 requirements, to protect from earthquake damage. Seismic Bracing shall be designed to withstand vertical forces and movement.
- Q. Install piping with grooved joints according to manufacturer's written instructions. Construct rigid piping joints, unless otherwise indicated, or required by NFPA 13 for flexibility in seismic zones.

- R. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- S. When a fire pipe crosses a seismic expansion joint it shall have a Metraflex fire loop installed at the joint in accordance with NFPA 13 chapter 9.

3.8 SPECIALTY SPRINKLER FITTING INSTALLATION

A. Install specialty sprinkler fittings according to manufacturer's written instructions.

3.9 VALVE INSTALLATION

- A. Refer to Division 23 Section "Valves" for installing general-duty valves. Install fire-protection specialty valves, trim, fittings, controls, and specialties according to NFPA 13 and NFPA 14, manufacturer's written instructions, and authorities having jurisdiction.
- B. Valves: Install fire-protection-service valves supervised-open, located to control sources of water supply except from fire department connections. Provide permanent identification signs indicating portion of system controlled by each valve.
- C. Double Check Valve Assemblies: Install valves in vertical up or horizontal position, per listings and for proper direction of flow.
- D. Deluge Valves: Install in vertical position, in proper direction flow, in main supply to deluge system.

3.10 SPRINKLER APPLICATIONS

- A. General: All sprinklers are to be quick response type. Sprinkler heads shall be of the latest design closed spray type for 155°F unless specified otherwise or required by code. Extended coverage heads shall not be used. Orifices larger than 1/2" may be used as required by density and spacing demands. Use sprinklers according to the following applications:
 - 1. Rooms without Ceilings: Upright and/or pendent sprinklers. Provide mechanical guards on all heads at or below 7'-0" height above the floor or where damage from room occupant use may occur.
 - 2. Rooms with Ceilings: Concealed sprinklers unless indicated otherwise.
 - 3. Wall Mounting: Concealed sidewall sprinklers unless indicated otherwise.
 - 4. Institutional sprinklers shall be installed in areas of detention, correctional or mental health care facilities.
 - 5. Spaces Subject to Freezing: Upright; pendent, dry-type; and sidewall, dry-type sprinklers.
 - 6. Provide freeze proof type automatic sprinkler heads serving unconditioned spaces, areas subject to freezing and in other areas requiring their use.
 - 7. Heads located within the air streams of unit heaters or other heat-emitting equipment shall be selected for proper temperature rating.
 - 8. Sprinkler Finishes: Use sprinklers with the following finishes:
 - a. Upright, Pendent, and Sidewall Sprinklers: Chrome in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view.

- b. Concealed Sprinklers: Rough brass, with White cover plate to match ceiling color.
- c. Semi-Recessed Sprinklers: White, with FMG approved white escutcheon.
- B. Sprinklers: Use the following:
 - 1. All sprinklers shall be listed, quick response type.
 - 2. Sprinkler in future finish spaces (shelled) 10' x 10' spacing shall be pendents/uprights installed with 1 x ½" bushing, to accommodate future finishes.
 - 3. Finish ceiling spaces shall have flat-plate concealed sprinklers.

3.11 SPRINKLER INSTALLATION

- A. Every effort shall be required to ensure that the heads form a symmetrical pattern in the ceiling with the ceiling grid if included, as well as lights, diffusers and grilles. Offsets shall be made in piping to accommodate ductwork in the ceiling. Heads shall be symmetrical in all ceilings and all piping run parallel or perpendicular to building lines. Heads shall be linearly aligned in corridors.
 - 1. In no case shall sprinkler heads be installed closer than approved distances from ceiling obstructions and HVAC ductwork.
 - 2. Sprinkler heads shall not conflict with tile grids.
 - 3. Sprinkler heads shall be located near center of corridors.
- B. Where layout of sprinkler heads is shown on reflected ceiling plans the locations shall be followed unless approval is obtained from the Architect or such locations shown do not meet the requirements of NFPA-13. In either case, approval of the Architect shall be obtained in writing before sprinkler head locations are changed. If the installation of additional heads is needed to conform to NFPA 13 requirements in areas where heads are shown on reflected ceiling plans, they shall be included in the contract price.
- C. Install sprinklers in patterns indicated.
- D. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use drytype sprinklers with water supply from heated space.
- E. Future finish shelled and tenant finish; Shell spaces shall be piped to accommodate future. Install sprinklers with 1" x ½" bushings, and space heads at a maximum spacing of 100 sq. ft. per head. Occupancy shall be Ordinary-Hazard Group 1 Design.
- F. Concealed type sprinkler shall be installed in the following areas:
 - 1. All areas.

3.12 HOSE-CONNECTION INSTALLATION

- A. Install hose connections adjacent to standpipes, unless otherwise indicated.
- B. Install freestanding hose connections for access and minimum passage restriction.
- C. Install NPS 2-1/2 hose connections with quick-disconnect NPS 2-1/2 by NPS 1-1/2 reducer adapter, cap and chain.

3.13 FIRE DEPARTMENT CONNECTION INSTALLATION

- A. When installing the Fire Department Connection, the contractor is to ensure that there are no permanent obstruction(s) as to the fire department access. If an obstruction is present immediately notify the designer and the design team before proceeding with the installation.
- B. Coordinate the exact location with the Architect and the Authority Having Jurisdiction.
- C. Install ball drip valves at each check valve for fire department connection. Drain to floor drain or outside building.

3.14 CONNECTIONS

- A. Connect water-supply piping and standpipes and sprinklers where indicated.
- B. Connect piping to specialty valves, hose valves, specialties, fire department connections, and accessories.
- C. Electrical Connections: Power wiring is specified in Division 28.
- D. Connect alarm devices to fire alarm.

3.15 LABELING AND IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and NFPA 14 and in Division 23 Section "Common Work Result for HVAC."

3.16 FIELD QUALITY CONTROL

- A. Flush, test, and inspect sprinkler piping according to NFPA 13, "System Acceptance" Chapter.
- B. Flush, test, and inspect standpipes according to NFPA 14, "Tests and Inspection" Chapter.
- C. Replace piping system components that do not pass test procedures and retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.
- D. When making a mechanical tee connection the coupon shall be attached at the mechanical tee
- E. Report test results promptly and in writing to Architect and authorities having jurisdiction.
- F. Whether the underground serving the sprinkler system is done by this contractor or another, this contractor will be responsible to assure and have in his possession a certificate that the underground has been flushed and tested by the contractor who installed it in accordance with NFPA-24 prior to connection of the underground piping to the overhead sprinkler system.

3.17 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers having paint other than factory finish.

3.18 PROTECTION

A. Protect sprinklers from damage until Substantial Completion.

3.19 COMMISSIONING

- A. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.
- B. Verify that specified tests of piping are complete and that "Material Test Certificates" are complete.
- C. Verify that damaged sprinklers and sprinklers with paint or coating not specified are replaced with new, correct type.
- D. Verify that sprinklers are correct types, have correct finishes and temperature ratings, and have guards as required for each application.
- E. Verify that hose connections and fire department connections have threads compatible with local fire department equipment.
- F. Fill wet-pipe sprinkler piping with water.
- G. Fill standpipes with water.
- H. Verify that hose connections are correct type and size.
- I. Coordinate with fire alarm tests. Operate as required.

3.20 DEMONSTRATION & TESTS

- A. Demonstrate equipment, specialties, and accessories. Review operating and maintenance information.
- B. All tests will be conducted as required by the local authority having jurisdiction, and in no case less than those required by NFPA standards. As a minimum, piping in the sprinkler system shall be tested at a water pressure at 200 psi for a period of not less two hours, or at 50 psi in excess of the normal pressure when the normal pressure is above 150 psi. Bracing shall be in place, and air shall be removed from the system through the hydrants and drain valves before the test pressure is applied. No apparent leaks will be permitted on interior or underground piping.
- C. The local jurisdiction having authority and the Utah State Fire Marshal's office (where required) shall be notified at least three working days in advance of all tests and flushing. This includes any flushing of underground, hydrostatic testing, or flow testing that may be required.
- D. This contractor shall make all the required tests to the sprinkler system as required by code. He shall be responsible to assure that the Contractor Test Certificates for the overhead,

- backflow and underground work are completed and delivered to the owner's insurance underwriter to assure proper insurance credit.
- E. All tests requiring the witnessing by local authorities will be the responsibility of this contractor. If tests are not run or do not have the proper witness, then they will be run later and all damage caused by the system, or caused in uncovering the system for such test, will be borne by this contractor.

3.21 WARRANTY

- A. This contractor shall warranty the sprinkler system and all its components for one year from the date of acceptance by the owner. Any costs incurred to extend any warranties of materials to assure this time frame shall be borne by this contractor.
- B. Provide Operation and Maintenance Manuals with correct as-builts test certificates and warranties included. A minimum 6 sets to be provided in red 3-ring binders. Include a current adopted version of NFPA 25 softbound copy left with owner.
- C. Electronic copy of AutoCAD as-built drawings shall also be provided on CD, with each O&M Manual.

3.22 FIELD QUALITY CONTROL

- A. Flush, test and inspect sprinkler piping according to NFPA 13, "System Acceptance" Chapter.
- B. Replace piping system components that do not pass test procedures and retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.
- C. Report test results promptly and in writing to Architect and authorities having jurisdiction.

END OF SECTION 211000

SECTION 22 0500

COMMON WORK RESULTS FOR PLUMBING

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. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Painting and finishing.
 - 4. Supports and anchorages.

1.3 SEISMIC REQUIREMENTS

- A. Seismic Performance: Equipment, pipe hangers and supports shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 220548 " Vibration and Seismic Controls for Plumbing Piping and Equipment.
 - For components with a seismic importance factor of 1.0 the term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified."
 - 2. For components with a seismic importance factor of 1.5 the term "withstand" means "the system 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."

1.4 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, and crawlspaces.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms, accessible pipe shafts, accessible plumbing chases and accessible tunnels.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Transition fittings.
- B. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.8 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. 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 maximum thickness unless thickness or specific material is 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.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
 - C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
 - D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
 - E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
 - F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

2.4 TRANSITION FITTINGS

- A. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
 - 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Fernco, Inc.
 - c. Mission Rubber Company.
 - d. Plastic Oddities, Inc.

PART 3 - EXECUTION

3.1 SEISMIC REQUIREMENTS

A. Comply with SEI/ASCE 7 and with requirements for seismic seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. 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.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- M. Verify final equipment locations for roughing-in.
- N. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. 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.
- E. 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.
- F. 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.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 PIPING CONNECTIONS

- A. 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. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 PAINTING

- A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

END OF SECTION

SECTION 22 0517

SLEEVES AND SLEEVE SEALS FOR PLUMBING 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. Sleeves.
 - 2. Grout.

1.3 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, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53, 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 GROUT

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

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 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.
 - Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. 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.
 - 3. 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 Division 07 Section "Joint Sealants."
 - 4. For sound-rated partitions, fill the opening between sleeve and piping with insulation prior to sealing.
- 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 Division 07 Section "Penetration Firestopping."

END OF SECTION

SECTION 22 0518

ESCUTCHEONS FOR PLUMBING 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. Escutcheons.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

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

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to 2 inch (50mm), tube, and insulation of insulated piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type with polished, chrome-plated finish.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.

- c. Insulated Piping: One-piece, stamped-steel type with chrome-plated finish.
- d. Bare Piping 2 inch and Smaller at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
- e. Bare Piping Larger than 2 inch at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type with polished, chrome-plated finish.
- f. Bare Piping 2 inch and Smaller at Ceiling Penetrations in Finished Spaces: Onepiece, cast-brass type with polished, chrome-plated finish.
- g. Bare Piping Larger than 2 inch at Ceiling Penetrations in Finished Spaces: Onepiece, stamped-steel type with polished, chrome-plated finish.
- h. Bare Piping 2 inch and Smaller in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated or rough-brass finish.
- i. Bare Piping Larger than 2 inch in Unfinished Service Spaces: One-piece, stamped-steel type with polished, chrome-plated finish.
- j. Bare Piping 2 inch and Smaller in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated or rough-brass finish.
- k. Bare Piping in Equipment Rooms Larger than 2 inch: One-piece, stamped-steel type with chrome- or cadmium-plated finish.

2. Escutcheons for Existing Piping to Remain:

- a. Chrome-Plated Piping: Split-casting, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
- b. Insulated Piping: Split-plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish
- c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
- d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
- e. Bare Piping in Unfinished Service Spaces: Split-plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
- f. Bare Piping in Equipment Rooms: Split-plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

SECTION 22 0523

GENERAL-DUTY VALVES FOR PLUMBING 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. Bronze angle valves.
- 2. Bronze ball valves.
- 3. Bronze lift check valves.
- 4. Bronze swing check valves.
- 5. Bronze gate valves.
- 6. Bronze globe valves.

B. Related Sections:

- Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
- 2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.
 - 3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
 - 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug-valve head.
 - 5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Gate Valves: With rising stem.
 - 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 3. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Grooved: With grooves according to AWWA C606.
 - 3. Solder Joint: With sockets according to ASME B16.18.
 - 4. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE ANGLE VALVES

- A. Class 125, Bronze Angle Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hammond Valve.
 - b. Milwaukee Valve Company.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron, bronze, or aluminum.

2.3 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Hammond Valve.
 - e. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corporation.
 - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Full.
- k. Class: 250
- B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Hammond Valve.
 - d. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.
- k. Class: 250
- C. Three-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. DynaQuip Controls.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Red-White Valve Corporation.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.

- c. CWP Rating: 600 psig.
- d. Body Design: Three piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Full.
- k. Class: 250
- D. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Hammond Valve.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Three piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.
 - k. Class: 250

2.4 BRONZE LIFT CHECK VALVES

- A. Class 125, Lift Check Valves with Bronze Disc:
 - Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 61 or ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

2.5 BRONZE SWING CHECK VALVES

- A. Class 125, Bronze Swing Check Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Red-White Valve Corporation.
 - k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - I. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 3.
- b. CWP Rating: 200 psig.
- c. Body Design: Horizontal flow, Y pattern.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.
- B. Class 150, Bronze Swing Check Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Kitz Corporation.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corporation.
 - i. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 3.
- b. CWP Rating: 300 psig.
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.
- g. Seat: EPDM or NBR.

2.6 BRONZE GLOBE VALVES

- A. Class 125, Bronze Globe Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Hammond Valve.
 - d. Kitz Corporation.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Powell Valves.
 - h. Red-White Valve Corporation.
 - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - j. Zy-Tech Global Industries, Inc.
 - k. Conbraco
 - I. Apollo

2. Description:

- a. Standard: MSS SP-80, Type 1.
- b. CWP Rating: 200 psig.
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded or solder joint.
- e. Stem and Disc: Bronze.
- f. Packing: Asbestos free.
- g. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

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

- D. Install valves in position to allow full stem movement.
- E. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball valves.
 - 2. Throttling Service Globe, angle, ball or butterfly valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valveend option is indicated in valve schedules below.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Bronze Angle Valves: Class 125 or Class 150, bronze disc.
 - 3. Ball Valves: One, Two or Three piece, full, bronze with bronze or stainless-steel trim.
 - 4. Bronze Swing Check Valves: Class 125 or Class 150, bronze disc.
 - 5. Bronze Globe Valves: Class 125 or Class 150, bronze disc.

END OF SECTION

SECTION 22 0529

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

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 hangers and supports for plumbing system piping and equipment:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Thermal-hanger shield inserts.
 - 4. Fastener systems.
 - 5. Pipe positioning systems.

B. Related Sections include the following:

- 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
- 2. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-suppression piping.
- 3. Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Seismic Performance: Plumbing equipment, hangers and supports shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment.

- For components with a seismic importance factor of 1.0 the term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified."
- 2. For components with a seismic importance factor of 1.5 the term "withstand" means "the system 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."

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.
 - 3. Powder-actuated fastener systems.
 - 4. Pipe positioning systems.
 - 5. Mechanical Anchors: ICC-ES Evaluation Reports validating 'Cracked Concrete' testing per A.C. 193 must be provided for anchors resisting seismic loads and/or supporting life-safety systems including fire sprinkler systems.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze pipe hangers. Include Product Data for components.
- C. Welding certificates.
- D. 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. Seismic calculations and detailed analysis: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices. Project specific design documentation and calculations shall be prepared and stamped by a registered professional engineer who is responsible for the seismic restraint design and who is licensed in the state where the project is being constructed (ASCE 7, 13.2.1.1).

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel.", AWS D1.4, "Structural Welding Code--Reinforcing Steel." and ASME Boiler and Pressure Vessel Code: Section IX.
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."

- 2. AWS D1.2, "Structural Welding Code--Aluminum."
- 3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
- 4. ASME Boiler and Pressure Vessel Code: Section IX.

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 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Manufacturers:

- 1. Anvil International.
- 2. AAA Technology & Specialties Co., Inc.
- 3. Bergen-Power Pipe Supports.
- 4. B-Line Systems, Inc.; a division of Cooper Industries.
- 5. Carpenter & Paterson, Inc.
- 6. Empire Industries, Inc.
- 7. ERICO/Michigan Hanger Co.
- 8. Globe Pipe Hanger Products, Inc.
- 9. Grinnell Corp.
- 10. GS Metals Corp.
- 11. National Pipe Hanger Corporation.
- 12. PHD Manufacturing, Inc.
- 13. PHS Industries, Inc.
- 14. Piping Technology & Products, Inc.
- 15. Tolco Inc.
- 16. Simpson Strong-Tie Co.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

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

2.4 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Manufacturers:
 - 1. Carpenter & Paterson, Inc.
 - 2. ERICO/Michigan Hanger Co.
 - 3. PHS Industries, Inc.
 - 4. Pipe Shields, Inc.
 - 5. Rilco Manufacturing Company, Inc.
 - 6. Value Engineered Products, Inc.
- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.
- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 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.
 - 1. Manufacturers:
 - a. Hilti, Inc.
 - b. MKT Fastening, LLC.
 - c. Powers Fasteners.
 - d. Simpson Strong-Tie Co.
- B. Mechanical-Expansion Anchors and Concrete Screws: Insert-wedge-type stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used. For anchors resisting seismic loads and/or supporting life- safety systems including fire sprinkler systems, Anchors shall have been tested for 'Cracked Concrete' per A.C. 193 per a valid ICC-ES Evaluation Report. Manufacturers with these anchors have been designated below with: '*'
 - 1. Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Empire Industries, Inc.
 - c. Hilti. Inc.
 - d. ITW Ramset/Red Head.
 - e. MKT Fastening, LLC.

- f. Powers Fasteners.
- g. Simpson Strong-Tie Co. *

2.6 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.
- B. Manufacturers:
 - 1. C & S Mfg. Corp.
 - 2. HOLDRITE Corp.; Hubbard Enterprises.
 - 3. Samco Stamping, Inc.

2.7 MISCELLANEOUS MATERIALS

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

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified 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 padded hangers for piping that is subject to scratching.
- F. 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 noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, 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 24, requiring clamp flexibility and up to 4 inches of insulation.

- 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
- 5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
- 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
- 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
- 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
- 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
- 10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
- 11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
- 12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
- 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
- 14. 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.
- 15. 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 and with U-bolt to retain pipe.
- 16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
- 17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
- 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
- 19. 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.
- 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
- 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. 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.
 - 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.

- 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
- 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - Steel or Malleable Concrete Inserts (MSS Type 18 or Simpson Blue Banger Concrete insert with UL & FM approvals): 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. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 - 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 - 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 - 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 - 11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 - 12. 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.
 - 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 - 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 - 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- J. 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.
- K. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- L. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- M. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
 - B. Steel 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 building structure.
 - C. 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 above for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
 - D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
 - E. Fastener System Installation:
 - 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. Powder actuated fasteners shall not be used for seismic bracing attachments.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. For anchors resisting seismic loads and/or supporting life-safety systems including fire sprinkler systems, anchors shall have been tested for 'Cracked Concrete' per A.C. 193 and shall have a valid ICC-ES Evaluation Report
 - F. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.
 - G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
 - 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 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 so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- M. Insulated Piping: Comply with the following:
 - 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.
 - Do not exceed pipe stress limits according to 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 inserts.
 - 6. Insert Material: Length at least as long as protective shield.
 - 7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

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 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 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. Touch Up: 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.
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- 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 22 0548

VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

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 restraints and vibration isolation as defined in Section 230548 "Vibration Isolation and Seismic Controls for HVAC" for the following:
 - 1. Plumbing Piping.

PART 2 - PRODUCTS

2.1 (NOT USED)

PART 3 - EXECUTION

3.1 (NOT USED)

END OF SECTION

SECTION 22 0553

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

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. Pipe labels.

 - Stencils.
 Valve tags.
 - 4. Ceiling grid

1.3 **SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full 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, 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 1-1/2 inches high.

2.2 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
 - 1. Stencil Material: Fiberboard or metal.
 - 2. Stencil Paint: Exterior, gloss, alkyd enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
 - Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated.

2.3 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

2.4 CEILING GRID

A. Provide valve identification for all plumbing and med gas valves located above the ceiling on the ceiling grid below the valve.

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 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09.
- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.
- C. 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 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 25 feet along each main run. Branch piping & piping in congested areas are to have labels spaced at maximum intervals of 6 feet.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
 - 8. On hard lid ceilings where piping enters and exits the room.

D. Pipe Label Color Schedule:

- 1. Domestic Water Piping:
 - a. Background Color: Comply with ASME A13.1.
 - b. Letter Color: Comply with ASME A13.1.
- 2. Sanitary Waste and Storm Drainage Piping:
 - a. Background Color: Comply with ASME A13.1.
 - b. Letter Color: Comply with ASME A13.1.

3.3 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawnwatering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 - 1. Valve-Tag Size and Shape:

- a. Cold Water: 1-1/2 inches, round.b. Hot Water: 1-1/2 inches, round.
- 2. Valve-Tag Color:
 - a. Cold Water: Comply with ASME A13.1.b. Hot Water: Comply with ASME A13.1.
- 3. Letter Color:
 - a. Cold Water: Comply with ASME A13.1.b. Hot Water: Comply with ASME A13.1.

END OF SECTION

SECTION 22 0719

PLUMBING PIPING 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 plumbing piping services:
 - 1. Domestic cold-water piping.
 - 2. Domestic hot-water piping.
 - 3. Domestic recirculating hot-water piping.
 - 4. Supplies and drains for handicap-accessible lavatories and sinks.

1.3 DEFINITIONS:

A. Refer to Section 220500 "Common Work Results for Plumbing".

1.4 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).
- 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, equipment connections, and access panels.
 - 6. Detail application of field-applied jackets.
 - 7. Detail application at linkages of control devices.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include

dates of tests and test methods employed.

1.6 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.

1.7 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.

1.8 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping 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.

1.9 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 "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. Insulation for below-ambient service requires a vapor-barrier.
- C. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- D. 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.
- E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- G. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000-Degree Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 - 2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A,
 - a. Without factory-applied jacket with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- H. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Ramco Insulation, Inc.; Super-Stik.
- B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 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-127.
- b. Eagle Bridges Marathon Industries; 225.
- c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
- d. Mon-Eco Industries, Inc.; 22-25.
- 2. 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).
- C. 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; 85-20.
 - d. 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).
- D. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 739, Dow Silicone.
 - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.: Welding Adhesive.
 - d. Speedline Corporation; Polyco VP Adhesive.
 - 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).

2.4 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. 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.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.
 - 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-30.
 - b. Eagle Bridges Marathon Industries; 501.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
 - d. Mon-Eco Industries, Inc.; 55-10.
 - 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
 - 3. Service Temperature Range: 0 to 180 deg F.
 - 4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
 - 5. Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
 - 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; Encacel.
 - b. Eagle Bridges Marathon Industries; 570.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
 - 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
 - 3. Service Temperature Range: Minus 50 to plus 220 deg F.
 - 4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 - Color: White.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
 - 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-10.
 - b. Eagle Bridges Marathon Industries: 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
 - 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: 60 percent by volume and 66 percent by weight.
 - 5. Color: White.

2.5 SEALANTS

- A. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:
 - 1. Products: Subject to compliance with requirements, provide the following:

- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
- 2. Materials shall be compatible with insulation materials, jackets, and substrates.
- 3. Fire- and water-resistant, flexible, elastomeric sealant.
- 4. Service Temperature Range: Minus 40 to plus 250 deg F.
- 5. Color: White.
- 6. 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).

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-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.7 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. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics. Inc.: FG Series.
 - c. Proto Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 - 2. Adhesive: As recommended by jacket material manufacturer.
 - Color: PVC, white: 30 mils thick...
 - 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.8 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. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
 - 2. Width: 2 inches.
 - 3. Thickness: 6 mils.
 - 4. Adhesion: 64 ounces force/inch in width.
 - 5. Elongation: 500 percent.
 - 6. Tensile Strength: 18 lbf/inch in width.

2.9 SECUREMENTS

A. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

2.10 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
 - Manufacturers: Subject to compliance with requirements provide products by one of the following:
 - a. Engineered Brass Company.
 - b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
 - c. McGuire Manufacturing.
 - d. Plumberex.
 - e. Truebro; a brand of IPS Corporation.
 - f. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
 - 2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
- B. Protective Shielding Piping Enclosures:
 - 1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
 - a. Truebro; a brand of IPS Corporation.
 - b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
 - 2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 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.
- 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.

3.3 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:
 - a. 2 inches o.c.
 - b. 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.

3.4 PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- B. 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.
- C. 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."

3.5 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 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:

- 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.

3.6 INSTALLATION OF MINERAL-FIBER 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:

- 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.

3.7 FIELD-APPLIED JACKET INSTALLATION

- A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
 - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.8 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. Insulation shall have a k value that meets the minimum requirements of the latest International Energy Conservation Code (IECC).
- C. 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.

3.9 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
 - 1. NPS 1-1/2 and Smaller: Insulation shall be one of the following;
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I:
 - 1) 1 inch thick
 - 2. NPS 2 and Larger: Insulation shall be one of the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation:
 - 1) 1 inches thick.
- B. Domestic Hot and Recirculated Hot Water:
 - 1. NPS 1-1/2 and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I:
 - 1) 1 inch thick.
 - 2. NPS 2 and Larger: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I:
 - 1) 1-1/2 inches thick

3.10 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. None.
- D. Piping, Exposed:
 - 1. PVC:
 - a. PVC, white: 30 mils thick.

END OF SECTION

SECTION 22 1116

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 SEISMIC REQUIREMENTS

- A. Seismic Performance: Pipe hangers and supports shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 230548 "Vibration and Seismic Controls for HVAC."
 - 1. For piping with a seismic importance factor of 1.0 the term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified."
 - 2. For piping with a seismic importance factor of 1.5 the term "withstand" means "the system 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."

1.4 ACTION SUBMITTALS

- A. Product Data: For transition fittings and dielectric fittings.
- B. Delegated-Design Submittal:
 - 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.

1.5 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

1.6 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 Construction Manager or owner no fewer than two days in advance of proposed interruption of water service.

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. Plastic piping components shall be marked with "NSF-pw."
- C. All piping shall be American made and tested; no import pipe will be permitted.
- D. All exposed water supply piping in toilet rooms, custodial rooms and kitchens shall be chromium plated.
- E. All piping installed in or passing through a plenum must be plenum rated, fire wrapped, or installed in a metal conduit.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, drawn temper.
- B. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. 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.
- G. Copper Pressure-Seal-Joint Fittings:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkhart Products Corporation.
 - b. NIBCO Inc.
 - c. Viega.
- 2. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
- H. Appurtenances for Grooved-End Copper Tubing:
 - Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International.
 - b. Shurjoint Piping Products.
 - c. Victaulic Company.

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. Flux: ASTM B 813, water flushable.
- E. 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 Nipples and Waterways:
 - 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. Clearflow/Perfection Corp.
 - e. Precision Plumbing Products, Inc.
 - f. Victaulic Company.
 - 2. Standard: IAPMO PS 66 or ASTM F-1545-97.
 - 3. Electroplated steel nipple or waterway complying with ASTM F 1545 or ANSI/NSF-61 Compliant.
 - 4. Pressure Rating and Temperature: 300 psig at 225 deg F.
 - 5. End Connections: Male threaded or grooved.
 - 6. Lining: Inert and noncorrosive, propylene or LTHS.

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 with 0.25 percent slope downward toward drain and plumb.
 - 1. Piping will be drained seasonally for freeze protection.
- D. Install seismic restraints on piping. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices in Division 22 Section "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 Division 22 Section "Meters and Gages for Plumbing Piping."
- N. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Division 22 Section "Domestic Water Pumps."
- O. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Division 22 Section "Meters and Gages for Plumbing Piping."
- P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing 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. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. 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. Transition Fittings in Underground Domestic Water Piping:
 - 1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
 - 2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

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 nipples/waterways.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric nipples/waterways.
- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric nipples/waterways.

3.5 HANGER AND SUPPORT INSTALLATION

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

- 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
- 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
- NPS 2-1/2: 108 inches with 1/2-inch rod.
- 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
- 6. NPS 6: 10 feet with 5/8-inch rod.
- 7. NPS 8: 10 feet with 3/4-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.
- G. 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.

3.7 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Division 22 Section "Identification for Plumbing 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 psigabove 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.
 - 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.
- Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
- c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
- d. Repeat procedures if biological examination shows contamination.
- e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.11 PIPING SCHEDULE

- A. Some piping types and sizes mentioned in this section may not be used on this project.
- B. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- C. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- D. All exposed water supply piping in toilet rooms, custodial rooms and kitchens shall be chromium plated.
- E. Aboveground domestic water piping, NPS 2and smaller, shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type L; cast- copper, solder-joint fittings; and soldered joints.
 - 2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
- F. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type L; cast- copper, brazed-joint fittings; and brazed joints.
 - 2. Victaulic grooved 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 for piping NPS 3 and smaller.
 - 2. Throttling Duty: Use ball valves for piping NPS 2 and smaller.
 - 3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
 - 4. Drain Duty: Hose-end drain valves.

B. Use check valves to mainta	in correct direction of domestic v	water flow to and from equipment.
	END OF SECTION	
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SECTION 22 1119

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. This Section includes the following domestic water piping specialties:
 - 1. Balancing valves.
 - 2. Temperature-actuated water mixing valves.
 - 3. Outlet boxes.
 - 4. Drain valves.
 - Water hammer arresters.

1.3 PERFORMANCE REQUIREMENTS

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

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. NSF Compliance:

- 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
- 2. Comply with NSF 61, "Drinking Water System Components Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 BALANCING VALVES

- A. Copper-Alloy Calibrated Balancing Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Flo Fab Inc.
 - c. ITT Industries; Bell & Gossett Div.
 - d. NIBCO INC.
 - e. TAC Americas.
 - f. Taco, Inc.
 - g. Victaulic
 - h. Watts Industries, Inc.; Water Products Div.
 - i. Nexus
 - j. Bell & Gossett
 - 2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.
 - 3. Body: bronze,
 - 4. Size: Same as connected piping, but not larger than NPS 2.
 - 5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.
- B. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.2 TEMPERATURE-ACTUATED WATER MIXING VALVES

- A. Individual-Fixture, Water Tempering Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cash Acme.
 - b. Conbraco Industries, Inc.
 - c. Honeywell Water Controls.
 - d. Lawler Manufacturing Company, Inc.
 - e. Leonard Valve Company.
 - f. Powers; a Watts Industries Co.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Zurn Plumbing Products Group; Wilkins Div.
 - Standard: ASSE 1070, thermostatically controlled water tempering valve.
 - 3. Pressure Rating: 125 psig minimum, unless otherwise indicated.
 - 4. Body: Bronze body with corrosion-resistant interior components.
 - 5. Temperature Control: Adjustable.
 - 6. Inlets and Outlet: Threaded.
 - 7. Finish: Rough or chrome-plated bronze.

2.3 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

- 1. Pressure Rating: Class 250
- 2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating 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.
- Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.020 inch.
 - b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
 - c. Strainers NPS 5 and Larger: 0.10 inch.
- 6. Drain: Factory-installed, hose-end drain valve.
- 7. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Flo Fab Inc.
 - c. ITT Industries; Bell & Gossett Div.
 - d. NIBCO INC.
 - e. TAC Americas.
 - f. Taco, Inc.
 - g. Victaulic
 - h. Watts Industries, Inc.; Water Products Div.
 - i. Nexus
 - i. Bell & Gossett

2.4 OUTLET BOXES

A. Icemaker Outlet Boxes:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company.
 - b. Guy Gray Manufacturing Co., Inc.
 - c. IPS Corporation.
 - d. LSP Products Group, Inc.
 - e. Oatey.
 - f. Plastic Oddities; a division of Diverse Corporate Technologies.
 - g. Symmons Industries, Inc.
 - h. Watts Industries, Inc.; Water Products Div.
 - i. Whitehall Manufacturing; a div. of Acorn Engineering Company.
 - j. Zurn Plumbing Products Group; Light Commercial Operation.
- 2. Mounting: Recessed.
- 3. Material and Finish: Enameled-steel or epoxy-painted-steel or plastic box and faceplate.
- 4. 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.
- 5. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.
- 6. Drain: NPS 2 standpipe and P-trap for direct waste connection to drainage piping.
- 7. Inlet Hoses: Two 60-inch- long, rubber household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.
- 8. Drain Hose: One 48-inch- long, rubber household clothes washer drain hose with

hooked end.

B. Water Outlet Boxes:

- Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company.
 - b. IPS Corporation.
 - c. LSP Products Group, Inc.
 - d. Oatey
 - e. Plastic Oddities; a division of Diverse Corporate Technologies.
- 2. Mounting: Recessed.
- 3. Material and Finish: Enameled-steel or epoxy-painted-steel or plastic box and faceplate.
- Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
- 5. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.5 DRAIN VALVES

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

2.6 WATER HAMMER ARRESTERS

- A. Water Hammer Arresters:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. PPP Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - g. Tyler Pipe; Wade Div.
 - h. Watts Drainage Products Inc.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASSE 1010 or PDI-WH 201.
 - 3. Type: Metal bellows or Copper tube with piston.
 - Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install balancing valves in locations where they can easily be adjusted.
- C. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - 1. Install thermometers and water regulators if specified.
 - 2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- D. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.
- E. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Calibrated balancing valves.
 - 2. Outlet boxes.
- 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 Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 ADJUSTING

A. Set field-adjustable flow set points of balancing valves.

Set field-adjustable temperature set points of temperature-actuated water mixing valves. B. **END OF SECTION**

SECTION 22 1316

SANITARY WASTE AND VENT 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. Pipe, tube, and fittings.
 - 2. Specialty pipe fittings.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 230548 "Vibration and Seismic Controls for HVAC."
 - 1. For piping with a seismic importance factor of 1.0 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."
 - 2. For piping with a seismic importance factor of 1.5 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 product indicated.

1.6 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.

1.7 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; "NSF-sewer" for plastic sewer piping; "NSF-drain" for plastic drain piping, and "NSF-tubular" for plastic continuous waste piping.

1.8 PROJECT CONDITIONS

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - Notify Construction Manager no fewer than two days in advance of proposed interruption of sanitary waste service.

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 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: All cast-iron waste, vent and sewer pipe and fittings shall be epoxy coated and shall conform to the requirements of CISPI Standard 301 and ASTM A 888. All products shall be listed by NSF International. Epoxy coated hubless cast iron soil pipe and fittings shall conform to ASTM A-888, most current revision, through an accredited third party organization that complies with ISO/IEC Guide 65 requirements. All epoxy coated hubless cast iron soil pipe shall be hydro tested at 5psi.
 - 1. Epoxy Coating
 - a. General: Epoxy coating on all hubless cast iron soil pipe and fittings shall be composed of two part epoxy resin with pigment and fillers. The epoxy shall have excellent resistance to water and alkali. The smooth surface shall result in a coefficient of friction of 130 Hazen-Williams or less.

- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NewAge Casting
 - b. AB&I Foundry
 - c. Charoltte Pipe
 - d. Tyler Pipe

B. CISPI, Hubless-Piping Couplings:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO.
 - b. Ideal
 - c. Mission Rubber Company; a division of MCP Industries, Inc.
 - d. Tyler Pipe.
- 2. Standards: ASTM C 1277 and CISPI 310.
- 3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- 4. Listing: Couplings shall be listed by NSF International. Each coupling shall be embossed with the NSF seal.
- C. Heavy-Duty, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Husky SD 4000.
 - b. Clamp-All Corp HI-TORQ 125.
 - 2. Standards: ASTM C 1277 and ASTM C 1540.
 - 3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

PART 3 - EXECUTION

3.1 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 to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Install seismic restraints on piping. Comply with SEI/ASCE 7 and with requirements for seismicrestraint devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. 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.
- 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 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.
- M. 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."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.
- N. Install engineered soil and waste drainage and vent piping systems as follows:
 - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
- O. Plumbing Specialties:
 - 1. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Division 22 Section "Sanitary Waste Piping Specialties."
- P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "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 Division 22 Section "Escutcheons for Plumbing Piping."

3.2 JOINT CONSTRUCTION

A. 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.

3.3 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Division 22 Section "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 and coupling or 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-inchod.
 - 4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
 - 5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
 - 6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.4 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 - 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. Comply with requirements for cleanouts and drains specified in Division 22 Section "Sanitary Waste Piping Specialties."
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make fixture and equipment 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.

3.5 IDENTIFICATION

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

3.6 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.

3.7 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.

3.8 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 3 and smaller shall be the following:
 - Hubless, cast-iron soil pipe and fittings CISPI hubless-piping couplings; and coupled ioints
 - 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- C. Aboveground, soil and waste piping NPS 4 and larger shall be the following:
 - Hubless, cast-iron soil pipe and fittings heavy-duty hubless-piping couplings; and coupled ioints.
 - 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- D. Aboveground, vent piping NPS 3 and smaller shall be the following:
 - 1. Hubless, cast-iron soil pipe and fittings CISPI hubless-piping couplings; and coupled joints.
 - 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

- E. Aboveground, vent piping NPS 4 and larger shall be the following:
 - 1. Hubless, cast-iron soil pipe and fittings CISPI hubless-piping couplings; and coupled joints.
 - 2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.

END OF SECTION

SECTION 22 1319

SANITARY WASTE 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. This Section includes the following sanitary drainage piping specialties:
 - 1. Cleanouts.
 - 2. Floor drains.
 - 3. Through-penetration firestop assemblies.
 - 4. Miscellaneous sanitary drainage piping specialties.
 - 5. Flashing materials.
- B. Related Sections include the following:
 - 1. Division 22 Section "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.

1.3 SEISMIC REQUIREMENTS

A. Seismic Performance: Plumbing equipment, hangers and supports shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment.

1.4 DEFINITIONS

- A. FOG: Fats, oils, and greases.
- B. FRP: Fiberglass-reinforced plastic.
- C. HDPE: High-density polyethylene plastic.
- D. PE: Polyethylene plastic.
- E. PP: Polypropylene plastic.
- F. PVC: Polyvinyl chloride plastic.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.
- C. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

- A. Exposed Metal Cleanouts:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB. Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
 - 3. Size: Same as connected drainage piping
 - 4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
 - 5. Closure: Countersunk, brass plug.
 - 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
 - 7. Closure: Stainless-steel plug with seal.

B. Metal Floor Cleanouts:

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

- a. Josam Company; Josam Div.
- b. Oatey.
- c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
- d. Tyler Pipe; Wade Div.
- e. Watts Drainage Products Inc.
- f. Zurn Plumbing Products Group; Light Commercial Operation.
- g. Zurn Plumbing Products Group; Specification Drainage Operation.
- 2. Standard: ASME A112.36.2M for adjustable housing cleanout.
- 3. Size: Same as connected branch.
- 4. Type: Adjustable housing.
- 5. Body or Ferrule: Cast iron.
- 6. Clamping Device: Required.
- 7. Outlet Connection: Inside calk.
- 8. Closure: Brass plug with tapered threads.
- 9. Adjustable Housing Material: Cast iron with threads.
- 10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
- 11. Frame and Cover Shape: Round.
- 12. Top Loading Classification: Heavy Duty.
- 13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
- 14. Standard: ASME A112.3.1.
- 15. Size: Same as connected branch.
- 16. Housing: Stainless steel.
- 17. Closure: Stainless steel with seal.
- 18. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB. Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
- 2. Standard: ASME A112.36.2M. Include wall access.
- 3. Size: Same as connected drainage piping.
- 4. Body: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
- 5. Closure: Countersunk, brass plug.
- 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- 7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
- 8. Wall Access: Round, stainless-steel wall-installation frame and cover.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

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

- a. Josam Company; Josam Div.
- b. MIFAB, Inc.
- c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
- d. Tyler Pipe; Wade Div.
- e. Watts Drainage Products Inc.
- f. Zurn Plumbing Products Group; Specification Drainage Operation.
- 2. Standard: ASME A112.6.3.
- 3. Body Material: Gray iron.
- 4. Seepage Flange: Required.
- 5. Anchor Flange: Not required.
- 6. Outlet: Bottom.
- 7. Trap Material: Cast iron>.
- 8. Trap Pattern: Deep-seal P-trap>.
- 9. Trap Features: Trap-seal primer valve drain connection>.

2.3 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ProSet Systems Inc.
- 3. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
- 4. Size: Same as connected soil, waste, or vent stack.
- 5. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
- 6. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
- 7. Special Coating: Corrosion resistant on interior of fittings.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps:

- 1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
- 2. Size: Same as connected waste piping.
 - a. NPS 2: 4-inch- minimum water seal.
 - b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

B. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch > above finished floor and galvanized-steel pipe extension

- in bottom of fitting that will extend through floor slab.
- 2. Size: As required for close fit to riser or stack piping.

2.5 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. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- C. Fasteners: Metal compatible with material and substrate being fastened.
- D. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- C. 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.
- D. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4. 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.
- E. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- F. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

- G. 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.
- H. Install deep-seal traps on all floor drains and other waste outlets, if indicated.
- I. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- J. Install wood-blocking reinforcement for wall-mounting-type specialties.
- K. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- L. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

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 Division 07 Section "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.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - Leak Test: After installation, charge system 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.

3.5 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

SECTION 22 4000

PLUMBING FIXTURES

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 conventional plumbing fixtures and related components:
 - 1. Protective shielding guards.
 - 2. Fixture supports.
 - Lavatories.
 - Commercial sinks.
- B. Related Sections include the following:
 - 1. Division 10 Section "Toilet, Bath, and Laundry Accessories."

1.3 DEFINITIONS

- A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
- C. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.
- D. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- E. FRP: Fiberglass-reinforced plastic.
- F. PMMA: Polymethyl methacrylate (acrylic) plastic.
- G. PVC: Polyvinyl chloride plastic.
- H. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials

- and finishes, dimensions, construction details, and flow-control rates.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.
- D. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
 - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 - 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 - 2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
 - 3. Slip-Resistant Bathing Surfaces: ASTM F 462.
 - 4. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
 - 5. Stainless-Steel Residential Sinks: ASME A112.19.3.
 - 6. Vitreous-China Fixtures: ASME A112.19.2M.
 - 7. Water-Closet, Flushometer Tank Trim: ASSE 1037.
- H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 - 1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
 - 2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 - 3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
 - 4. Faucets: ASME A112.18.1.
 - 5. Hose-Connection Vacuum Breakers: ASSE 1011.
 - 6. Hose-Coupling Threads: ASME B1.20.7.

- 7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
- 8. NSF Potable-Water Materials: NSF 61.
- 9. Pipe Threads: ASME B1.20.1.
- 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
- 11. Supply Fittings: ASME A112.18.1.
- 12. Brass Waste Fittings: ASME A112.18.2.
- 13. NSF61 Appendage G-AB 1953. Lead free potable drinking faucets.
- I. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
 - 1. Atmospheric Vacuum Breakers: ASSE 1001.
 - 2. Brass and Copper Supplies: ASME A112.18.1.
 - 3. Dishwasher Air-Gap Fittings: ASSE 1021.
 - 4. Manual-Operation Flushometers: ASSE 1037.
 - 5. Plastic Tubular Fittings: ASTM F 409.
 - 6. Brass Waste Fittings: ASME A112.18.2.
 - 7. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
 - 8. NSF61 Appendage G-AB 1953. Lead free potable drinking faucets.
- J. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Disposers: ASSE 1008 and UL 430.
 - 2. Dishwasher Air-Gap Fittings: ASSE 1021.
 - Flexible Water Connectors: ASME A112.18.6.
 - 4. Floor Drains: ASME A112.6.3.
 - 5. Grab Bars: ASTM F 446.
 - 6. Hose-Coupling Threads: ASME B1.20.7.
 - 7. Off-Floor Fixture Supports: ASME A112.6.1M.
 - 8. Pipe Threads: ASME B1.20.1.
 - 9. Plastic Toilet Seats: ANSI Z124.5.
 - 10. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. 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.
 - 3. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.

PART 2 - PRODUCTS

2.1 LAVATORY FAUCETS

- A. Lavatory Faucets:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the

following:

a. Chicago Faucets.

2.2 SINK FAUCETS

A. Sink Faucets:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Chicago Faucets.

2.3 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Engineered Brass Co.
 - b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
 - c. McGuire Manufacturing Co., Inc.
 - d. Plumberex Specialty Products Inc.
 - e. TCI Products.
 - f. TRUEBRO, Inc.
 - g. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.
 - 2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements. Product shall also meet the ASTM E 84 25/450 smoke and flame rating.
- B. Protective Shielding Piping Enclosures:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. TRUEBRO, Inc.
 - 2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

2.4 FIXTURE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Josam Company.
 - 2. MIFAB Manufacturing Inc.
 - 3. Smith, Jay R. Mfg. Co.
 - 4. Tyler Pipe; Wade Div.
 - 5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.

6. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Urinal Supports:

- 1. Description: Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture for wall-mounting, urinal-type fixture. Include steel uprights with feet.
- 2. Accessible-Fixture Support: Include rectangular steel uprights.

C. Lavatory Supports:

- 1. Description: Type II, lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
- 2. Accessible-Fixture Support: Include rectangular steel uprights.

2.5 LAVATORIES

A. Lavatories:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.
 - b. Kohler Co.

2.6 COMMERCIAL SINKS

A. Commercial Sinks:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkay Manufacturing Co.
 - b. Just Manufacturing Company.

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 plumbing fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install wall-mounting fixtures with tubular waste piping attached to supports.
- D. Install counter-mounting fixtures in and attached to casework.
- E. Install fixtures level and plumb according to roughing-in drawings.
- F. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
 - 1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- G. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- H. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- I. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- J. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- K. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- L. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- M. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- N. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."
- U. All plumbing fixtures are to be mounted at the height specified on the Architectural drawings.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent

piping. Use size fittings required to match fixtures.

3.4 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow and stream.
- C. Replace washers and seals of leaking and dripping faucets and stops.

3.6 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - 2. Remove sediment and debris from drains.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 23 0100

MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL CONDITIONS

- A. The General Conditions of the Contract, with the amendments, supplements, forms and requirements in Division 01, and herewith made a part of this Division.
- B. All sections of Division 21, 22, & 23 shall comply with the Mechanical General Requirements. The standards established in this section as to quality of materials and equipment, the type and quality of workmanship, mode of operations, safety rules, code requirements, etc., shall apply to all sections of this Division as though they were repeated in each Division.
- C. Mechanical equipment that is pre-purchased if any will be assigned to the Mechanical Contractor. By assignment to the Mechanical Contractor, the Mechanical Contractor shall accept and installed the equipment and provide all warrantees and guarantees as if the Mechanical Contractor had purchased the equipment.
- D. Construction Indoor-Air Quality Management
 - Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."
 - a. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Division 01 Section "Temporary Facilities and Controls," install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
 - b. Replace all air filters immediately prior to occupancy.
 - 2. Comply with one of the following requirements:
 - a. After Construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total volume of 14000 cu. Ft. of outdoor air per sq. ft. of floor area while maintaining an internal temperature of at least 60 deg F and a relative humidity no higher than 60 percent.
 - b. If occupancy is desired prior to flush-out completion, the space may be occupied following delivery of a minimum of 3500 cu. ft. of outdoor air per sq. ft. of floor area to the space. Once a space is occupied, it shall be ventilated at a minimum rate of 0.30 cfm per sq. ft. of outside air or the design minimum outside air rate determined in EQ Prerequisite 1, whichever is greater. During each day of the flush-out period, ventilation shall begin a minimum of three hours prior to occupancy and continue during occupancy. These conditions shall be maintained until a total of 14000 cu. ft./sq. ft. of outside air has been delivered to the space.

E. LEED REQUIREMENT

The Contractor is to submit all LEED information needed by the Design Professional to demonstrate that particular credits have been achieved. In particular, credits that depend on knowing the cost and quantity of certain types of products cannot be achieved without obtaining that information from the Contractor. These include renewable content, locally sourced new products, and reused products. In addition, a form is provided for each installer to certify that they have not used adhesives, sealants, and for suppliers and installers to certify they have not used composite wood with prohibited VOC content.

1.2 SCOPE OF WORK

- A. The project described herein is the Primary Children's Ambulatory Care Center. This work shall include all labor, materials, equipment, fixtures, and devices for the entire mechanical work and a complete operating and tested installation as required for this project.
- B. This Division will schedule the boiler inspection and pay for all costs associated with certifying the boiler with the state.

1.3 CODES & ORDINANCES

A. All work shall be executed in accordance with all underwriters, public utilities, local and state rules and regulations applicable to the trade affected. Should any change in the plans and Specifications be required to comply with these regulations, the Contractor shall notify the Architect before the time of submitting his bid. After entering into contract, the Contractor will be held to complete all work necessary to meet these requirements without extra expense to the Owner. Where work required by drawings or specifications is above the standard required, it shall be done as shown or specified.

B. Applicable codes:

- 1. Utah Boiler and Pressure Vessel Rules and Regulations- Latest Edition
- 2. International Building Code- 2018 Edition
- 3. International Mechanical Code- 2018 Edition
- 4. International Plumbing Code- 2018 Edition
- 5. International Fire Code- 2018 Edition
- 6. ASHRAE Standard 90.1 2016 Edition
- 7. International Fuel Gas Code- 2018 Edition
- 8. National Electrical Code- 2016 Edition
- 9. ASHRAE Standard 62.1 2016 Edition
- 10. ASHRAE Standard 170 2017 Edition

1.4 INDUSTRY STANDARDS

- A. All work shall comply with the following standards.
 - 1. Associated Air Balance council (AABC)
 - 2. Air Conditioning and Refrigeration Institute (ARI)
 - 3. Air Diffusion council (ADC)
 - 4. Air Movement and Control Association (AMCA)
 - 5. American Gas Association (AGA)
 - 6. American National Standards Institute (ANSI)
 - 7. American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)
 - 8. American Society of Mechanical Engineers (ASME)
 - 9. American Society of Testing Materials (ASTM)
 - 10. American Water Works Association (AWWA)
 - 11. Cooling Tower Institute (CTI)
 - 12. ETL Testing Laboratories (ETL)
 - 13. Institute of Electrical and Electronic Engineers (IEEE)
 - 14. Hydronics Institute (HI)
 - 15. Manufacturers Standardization Society of the Valve and Fitting Industry (MSS)
 - 16. National Fire Protection Association (NFPA)
 - 17. National Electrical Code (NEC)
 - 18. National Electrical Manufacturers Association (NEMA)
 - 19. National Electrical Safety code (NESC)
 - 20. Utah safety Standard (OSHA), Utah State Industrial Council.
 - 21. Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
 - 22. Underwriters Laboratories (UL)
 - 23. Tubular Exchanger Manufacturers Association, Inc. (TEMA)

- 24. Heat Exchanger Institute (HEI)
- 25. Hydraulic Institute (HI)
- 26. Thermal Insulation Manufacturer=s Association (TIMA)
- 27. Scientific Apparatus Makers Association (SAMA)

B. Compliance Verification:

- All items required by code or specified to conform to the ASME code shall be stamped with the ASME seal.
- 2. Form U-1, the manufacturer=s data report for pressure vessels, is to be included in the Operation and Maintenance Manuals. National Board Register (NBR) numbers shall be provided where required by code.
- 3. Manufactured equipment which is represented by a UL classification and/or listing, shall bear the UL or equivalent ETL label.

1.5 UTILITIES & FEES

A. All fees for permits required by this work will be paid by this division with the understanding that any fees that are required to be paid will be reimbursed by the owner. The contractor shall obtain the necessary permits to perform this work. Unless noted otherwise, all systems furnished and or installed by this Contractor, shall be complete with all utilities, components, commodities and accessories required for a fully functioning system. This Contractor shall furnish smoke generators when required for testing, furnish glycol for glycol piping systems, full load of salt to fill brine tank for water softening system, furnish cleaners and water treatment additives.

1.6 SUBMITTALS AND SHOP DRAWINGS

- A. General: As soon as possible after the contract is awarded, but in no case more than 45 calendar days thereafter, the Contractor shall submit to the Architect manufacturer's data on products and materials to be used in the installation of mechanical systems for this project. The review of the submitted data will require a minimum of 14 days. The first day starts after the day they are received in the engineer's office to which the project is being constructed from. If the Contractors schedule requires return of submitted literature in less than the allotted time, the Contractor shall accelerate his submittal delivery date. The Contractor shall resubmit all items requiring re-review within 14 days of returned submittals. Refer to each specification section for items requiring submittal review. If the re-submittal is returned a 2nd time for correction the Contractor will provide the specific equipment that is specified on the drawings and/or the specifications. Written approval of the Owner's Representative shall be obtained before installing any such equipment or materials for the project.
- B. Review by the Owner's Representative is for general conformance of the submitted equipment to the project specification. In no way does such review relieve this Contractor of his obligation to furnish equipment and materials that comply in detail to the specification nor does it relieve the Contractor of his obligation to determine actual field dimensions and conditions that may affect his work. Regardless of any items overlooked by the submittal review, the requirements of the contract drawings and specifications must be followed and are not waived or superseded in any way by the review.
- C. By description, catalog number, and manufacturer's names, standards of quality have been established by the Architect and the Engineer for certain manufactured equipment items and specialties that are to be furnished by this Division. Alternate products and equipment may be proposed for use only if specifically named in the specifications or if given written prior approval in published addenda. Design equipment is the equipment listed on the drawings or if not listed on the drawings is the equipment first named in the specifications.
- D. Submittal Format: At the contractor's discretion, project submittals may be in either of the formats described in the following paragraphs, but mixing the two formats is not acceptable.

- 1. Electronic Submittal Format: Identify and incorporate information in each electronic submittal file as follows:
 - a. All items shall be submitted at one time except automatic temperature control drawings and seismic restraint drawings which may be submitted separately within 120 days of the contract award date. Partial submittals will not be reviewed until the complete submittal is received.
 - b. Submitted electronic file shall bear the Contractor's stamp, indicating that he has checked all equipment being submitted; that each item will fit into the available space with the accesses shown on the drawings; and, further, that each item conforms to the capacity and quality standards given in the contract documents.
 - c. Submitted electronic file shall clearly indicate performance, quality, and utility requirements; shall show dimension and size of connection points; and shall include derating factors that were applied for each item of equipment to provide capacity at job site elevation. Temperature control submittals shall include piping and wiring diagrams, sequence of operation and equipment. Equipment must fit into the available space with allowance for operation, maintenance, etc. Factory piped and wired equipment shall include shop drawings for all internal wiring and piping furnished with the unit.
 - d. Submitted electronic file shall clearly show all required field install wiring, piping, and accessory installations required by the Contractor to provide a complete operating system.
 - e. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 - f. Name file with submittal number or other unique identifier, including revision identifier.
 - g. Electronic file shall be completely electronically searchable or it will be rejected.
 - h. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by:
 - 1) Architect.
 - i. Transmittal Form for Electronic Submittals:
 - 1) Use one of the following options acceptable to the Owner;
 - a) Software-generated form from electronic project management software.
 - b) Electronic form.
 - 2) The Electronic Submittal shall contain the following information:
 - a) Project name.
 - b) Date.
 - c) Name and address of Architect.
 - d) Name of Construction Manager.
 - e) Name of Contractor.
 - f) Name of firm or entity that prepared submittal.
 - g) Names of subcontractor, manufacturer, and supplier.
 - h) Category and type of submittal.
 - i) Submittal purpose and description.
 - i) Specification Section number and title.
 - k) Specification paragraph number or drawing designation and generic name for each of multiple items.
 - I) Drawing number and detail references, as appropriate.
 - m) Location(s) where product is to be installed, as appropriate.
 - n) Related physical samples submitted directly.
 - o) Indication of full or partial submittal.
 - p) Transmittal number[, numbered consecutively].
 - q) Submittal and transmittal distribution record.
 - r) Other necessary identification.
 - s) Remarks.

- Metadata: Include the following information as keywords in the electronic submittal file metadata:
 - 1) Project name.
 - 2) Number and title of appropriate Specification Section.
 - 3) Manufacturer name.
 - 4) Product name.
- E. Submittal Requirements Submittals MUST be compiled in PDF format, organized, properly labeled with specification sections, and book marked.
 - Mail physical samples to Archer Mechanical 2745 W. California Ave., Salt Lake City, UT 84104
 - 2. Submittal files larger than 25MB must be delivered to the Archer Mechanical office via thumb drive.
 - 3. Subcontractor/Vendor markups should be purple. GC markups will be blue, architect markups will be red, and consultant markups will be green. Any variations of sizing and/or performance shall be clearly indicated with an explanation of variation.
 - 4. Submittals must be submitted no later than two weeks from notice.
 - 5. Partial submittals will not be accepted. All required test data, certifications, qualification data, schedules, shop drawings, test reports, etc. must be included.
 - 6. Substitutions not previously accepted will not be allowed in submittals.
 - 7. All clarifications and questions about scope of work must be submitted in RFI(s) rather than in submittals
 - 8. Specific schedule of lead times for all items that are not 'off the shelf' must be submitted within 10 days of NTP. (See schedule requirements)

1.7 DRAWINGS AND MEASUREMENTS

- A. Construction Drawings: The contract document drawings show the general design, arrangements, and extent of the system. In certain cases, the drawings may include details that show more nearly exact locations and arrangements; however, the locations, as shown diagrammatically, are to be regarded as general.
- B. It shall be the work of this Section to make such slight alterations as may be necessary to make adjustable parts fit to fixed parts, leaving all complete and in proper shape when done. All dimensions given on the drawings shall be verified as related to this work and with the Architect's office before work is started.
- C. This Section shall carefully study building sections, space, clearances, etc., and then provide offsets in piping or ductwork as required to accommodate the building structure without additional cost to the Owner. In any case and at any time during the construction process, a change in location required by obstacles or the installation of other trades not shown on the mechanical plans shall be made without charge.
- D. The drawings shall not be scaled for roughing in measurements nor shall they be used as shop drawings. Where drawings are required for these purposes or where drawings must be made from field measurements, the Contractor shall take the necessary measurements and prepare the drawings. Shop drawings of the various subcontractors shall be coordinated to eliminate all interferences and to provide sufficient space for the installation of all equipment, piping, ductwork, etc.
- E. The drawings and specifications have been prepared to supplement each other and they shall be interpreted as an integral unit with items shown on one and not the other being furnished and installed as though shown and called out on both.
- F. Coordination Drawings: The contractor shall provide coordination drawings for mechanical rooms, fan rooms, equipment rooms, and congested areas to eliminate conflicts with equipment, piping, or work of other trades. The drawings shall be a minimum scale of 1/4 inch= 1 foot and of such detail

- as may be required by the Engineer to fully illustrate the work. These drawings shall include all piping, conduit, valves, equipment, and ductwork.
- G. Sheet-metal shop drawings will be required for all ductwork in the entire building. These drawings will show all ductwork in the entire building and shall be coordinated with architectural, structural and electrical portions of the project. The contractor shall specifically obtain copies of the structural shop drawings and shall coordinate the ductwork shop drawings with approved structural members. These drawings shall be submitted to the engineer for review prior to any fabrication. The contractor is responsible for all modifications necessary to accommodate duct installation within the structural, architectural and electrical restrictions. These drawings, once reviewed by the engineer, will be made available to all mechanical, electrical, and fire sprinkler subcontractors to coordinate installation of their work.

1.8 CONTRACTOR'S USE OF BUILDING EQUIPMENT

A. The Contractor may use equipment such as electric motors, fans, heat exchangers, filters, etc., with the written permission of the Owner. As each piece of equipment is used (such as electric motors and fans), maintenance procedures approved by the manufacturer are to be followed. A careful record is to be kept of the length of the time the equipment is used, maintenance procedures followed, and any difficulty encountered. The record is to be submitted to the Owner upon acceptance. All fan belts and filter media (such as bearings) shall be carefully inspected just prior to acceptance. Any excessive wear noted shall require replacement. New filter media shall be installed in air handlers at the time systems are turned over to the owner.

1.9 EXISTING CONDITIONS

- A. The Contractor shall carefully examine all existing conditions that might affect the mechanical system and shall compare these conditions with all drawings and specifications for work included under this contract. He shall, at such time, ascertain and check all conditions that may affect his work. No allowance shall subsequently be made in his behalf for an extra expense incurred as a result of his failure or neglect to make such examination. This Contractor shall include in his bid proposal all necessary allowances to repair or replace any item that will remain or will be removed, and any item that will be damaged or destroyed by new construction.
- B. The Contractor shall remove all abandoned piping, etc., required by new construction and cap or plug openings. No capping, etc., shall be exposed in occupied areas. All openings of items removed shall be sealed to match adjacent surfaces.
- C. The Contractor shall verify the exact location of all existing services, utilities, piping, etc., and make connections to existing systems as required or as shown on the drawings. The exact location of each utility line, together with size and elevation, shall be established before any on-site lines are installed. Should elevation or size of existing main utility lines make connections to them impossible as shown on drawings, then notification of such shall immediately be given to the Owners Representative for a decision.
- D. Any HVAC system that is modified shall be rebalanced and recommissioned additional requirements. If the unit modified serves more than the area under the current scope of work, the entire area served by that unit must be re-balanced and recommissioned.

1.10 EQUIPMENT CAPACITIES

A. Capacities shown for equipment in the specifications and on the drawings are the minimum acceptable. No equipment shall be considered as an alternate that has capacities or performance less than that of design equipment.

B. All equipment shall give the specified capacity and performance at the job-site elevation. Manufacturers' standard ratings shall be adjusted accordingly. All capacities and performances listed on drawings or in specifications are for job-site conditions.

1.11 SEISMIC REQUIREMENTS FOR EQUIPMENT

A. All equipment shall be furnished structurally adequate to withstand seismic forces as outlined in the International Building Code. Refer to section Mechanical Vibration Controls and Seismic Restraints. Equipment bases shall be designed for direct attachment of seismic snubbers and/or seismic anchors.

1.12 COOPERATION WITH OTHER TRADES

- A. The Contractor shall refer to other drawings and parts of this specification that cover work of other trades that is carried on in conjunction with the mechanical work such that all work can proceed without interference resulting from lack of coordination.
- B. The Contractor shall properly size and locate all openings, chases, sleeves, equipment bases, and accesses. He shall provide accurate wiring diagrams to the Electrical Contractor for all equipment furnished under this Division.
- C. The ceiling cavity must be carefully reviewed and coordinated with all trades. In the event of conflict, the installation of the mechanical equipment and piping shall be in the following order: plumbing, waste, and soil lines; supply, return, and exhaust ductwork; water piping; medical gases; fire protection piping; and pneumatic control piping.
- D. The mechanical Contractor shall insure that the installation of all piping, ducts and equipment is in compliance with Articles 110-16 and 384-4 of the National Electrical Code relative to proper clearances in front of and over all electrical panels and equipment. No piping or ductwork will be allowed to run over electrical panel.

1.13 RESPONSIBILITY OF CONTRACTOR

- A. The Contractor is responsible for the installation of a satisfactory piece of work in accordance with the true intent of the drawings and specifications. He shall provide, as a part of his work and without expense, all incidental items required even though these items are not particularly specified or indicated. The installation shall be made so that its several component parts will function together as a workable system and shall be left with all equipment properly adjusted and in working order. The Contractor shall familiarize the Owner's Representative with maintenance and lubrication instructions as prepared by the Contractor and shall explain and fully instruct him relative to operating, servicing, and maintenance of them.
- B. If a conflict arises between the drawings and the specifications the most stringent procedure/action shall be followed. A clarification to the engineer will help to determine the course of action to be taken. If a conflict arises between specification sections the engineer will determine which course of action is to be followed.

1.14 PIPE AND DUCT OPENINGS AND EQUIPMENT RECESSES

A. Pipe and duct chases, openings, and equipment recesses shall be provided by others only if shown on architectural or structural drawings. All openings for the mechanical work, except where plans and specifications indicate otherwise, shall be provided as work of this Division. Include openings information with coordination drawings.

B. Whether chases, recesses, and openings are provided as work of this Division or by others, this Contractor shall supervise their construction and be responsible for the correct size and location even though detailed and dimensioned on the drawings. This Contractor shall pay for all necessary cutting, repairing, and finishing if any are left out or incorrectly made. All necessary openings thru existing walls, ceilings, floors, roofs, etc. shall be provided by this Contractor unless indicated otherwise by the drawing and/or specifications.

1.15 UNFIT OR DAMAGED WORK

A. Any part of this installation that fails, is unfit, or becomes damaged during construction, shall be replaced or otherwise made good. The cost of such remedy shall be the responsibility of this Division.

1.16 WORKMANSHIP

A. Workmanship shall be the best quality of its kind for the respective industries, trades, crafts, and practices, and shall be acceptable in every respect to the Owner's representative. Nothing contained herein shall relieve the Contractor from making good and perfect work in all details in construction.

1.17 SAFETY REGULATION

A. The Contractor shall comply with all local, Federal, and OSHA safety requirements in performance with this work. (See General Conditions). This Contractor shall be required to provide equipment, supervision, construction, procedures, and all other necessary items to assure safety to life and property.

1.18 ELECTRICAL SERVICES

- A. All equipment control wiring and all automatic temperature control wiring including all necessary contacts, relays, and interlocks, whether low or line voltage, except power wiring, shall be furnished and installed as work of this Division unless shown to be furnished by Division 26. All such wiring shall be in conduit as required by electrical codes. Wiring in the mechanical rooms, fans rooms and inaccessible ceilings and walls shall be installed in conduit as well. Installation of any and all wiring done under Division 21, 22 and 23 shall be in accordance with the requirements of Division 26, Electrical.
- B. All equipment that requires an electrical connection shall be furnished so that it will operate properly and deliver full capacity on the electrical service available.
- C. Refer to the electrical control equipment and wiring shown on the diagrams. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment.
- D. The Mechanical Contractor must coordinate with the Electrical Contractor to insure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of such coordination.

1.19 WORK, MATERIALS, AND QUALITY OF EQUIPMENT

A. Unless otherwise specified, all materials shall be new and of the best quality of their respective kinds and all labor shall be done in a most thorough and workmanlike manner.

- B. Products or equipment of any of the manufacturers cited herein or any of the products approved by the Addenda may be used. However, where lists of products are cited herein, the one first listed in the design equipment used in drawings and schedules to establish size, quality, function, and capacity standards. If other than design equipment is used, it shall be carefully checked for access to equipment, electrical and control requirements, valving, and piping. Should changes or additions occur in piping, valving, electrical work, etc., or if the work of other Contractors would be revised by the alternate equipment, the cost of all changes shall be borne as work of this Division.
- C. The Execution portions of the specifications specify what products and materials may be used. Any products listed in the Product section of the specification that are not listed in the Execution portion of the specification may not be used without written approval by the Engineer.
- D. The access to equipment shown on the drawings is the minimum acceptable space requirements. No equipment that reduces or restricts accessibility to this or any other equipment will be considered.
- E. All major items of equipment are specified in the equipment schedules on the drawings or in these specifications and shall be furnished complete with all accessories normally supplied with the catalog item listed and all other accessories necessary for a complete and satisfactory installation.
- F. All welders shall be certified in accordance with Section IX of the ASME Boiler and Pressure Vessel Code, latest Edition.

1.20 PROTECTION AGAINST WEATHER AND STORING OF MATERIALS

- A. All equipment and materials shall be properly stored and protected against moisture, dust, and wind. Coverings or other protection shall be used on all items that may be damaged or rusted or may have performance impaired by adverse weather or moisture conditions. Damage or defect developing before acceptance of the work shall be made good at the Contractor's expense.
- B. All open duct and pipe openings shall be adequately covered at all times.

1.21 INSTALLATION CHECK

- A. An experienced, competent, and authorized representative of the manufacturer or supplier of each item of equipment indicated in the equipment schedule and the seismic supplier shall visit the site of the work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the equipment supplier's representative shall be present when the equipment is placed in operation. The equipment supplier's representative shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation is satisfactory to the Engineer.
- B. Each equipment supplier's representative shall furnish to the Owner, through the Engineer, a written report certifying that the equipment (1) has been properly installed and lubricated; (2) is in accurate alignment; (3) is free from any undue stress imposed by connecting piping or anchor bolts; and, (4) has been operated under full load conditions and that it operated satisfactorily.
- C. All costs for this work shall be included in the prices quoted by equipment suppliers.

1.22 EQUIPMENT LUBRICATION

A. The Contractor shall properly lubricate all pieces of equipment before turning the building over to the Owner. A linen tag shall be attached to each piece of equipment, showing the date of lubrication and the lubricant used. No equipment shall be started until it is properly lubricated.

- B. Necessary time shall be spent with the Owner's Representative to thoroughly familiarize him with all necessary lubrications and maintenance that will be required of him.
- C. Detergent oil as used for automotive purposes shall not be used for this work.

1.23 CUTTING AND PATCHING

- A. No cutting or drilling in structural members shall be done without written approval of the Architect. The work shall be carefully laid out in advance, and cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces necessary for the mechanical work shall be carefully done. Any damage to building, piping, or equipment shall be repaired by professional plasterers, masons, concrete workers, etc., and all such work shall be paid for as work of this Division.
- B. When concrete, grading, etc., is disturbed, it shall be restored to original condition as described in the applicable Division of this Specification.

1.24 EXCAVATION AND BACKFILLING

- A. All necessary excavations and backfilling for the Mechanical phase of this project shall be provided as work of this Division. Trenches for all underground pipelines shall be excavated to the required depths. The bottom of trenches shall be compacted hard and graded to obtain required fall. Backfill shall be placed in horizontal layers, not exceeding 12 inches in thickness, and properly moistened. Each layer shall be compacted, by suitable equipment, to a density of not less than 95 percent as determined by ASTM D-1557. After pipelines have been tested, inspected, and approved, the trench shall be backfilled with selected material. Excess earth shall be hauled from the job site. Fill materials approved by the Architect shall be provided as work of this Division.
- B. No trenches shall be cut near or under any footings without consultation first with the Architect's office. Any trenches or excavations more than 30 inches deep shall be tapered, shored, covered, or otherwise made absolutely safe so that no vehicle or persons can be injured by falling into such excavations, or in any way be harmed by cave-ins, shifting earth, rolling rocks, or by drowning. This protection shall be extended to all persons approaching excavation related to this work whether or not such persons are authorized to be in the vicinity of the construction.

1.25 ACCESS

- A. Provide access doors in walls, ceilings and floors by this division unless otherwise noted. For access to mechanical equipment such as valves, dampers, VAV boxes, fans, controls, etc. Refer to Division 8 for door specifications. All access doors shall be 24" x 24" unless otherwise indicated or required. Coordinate location of doors with the Architect prior to installation. If doors are not specified in Division 8, provide the following: Doors in ceilings and wall shall be equal to JR Smith No. 4760 bonderized and painted. Doors in tile walls shall be equal to JR Smith No. 4730 chrome plated. Doors in floors shall be equal to JR Smith No. 4910
- B. Valves: Valve must be installed in locations where access is readily available. If access is compromised, as judged by the Mechanical Engineer, these valves shall be relocated where directed at the Contractors expense.
- C. Equipment: Equipment must be installed in locations and orientations so that access to all components requiring service or maintenance will not be compromised. If access is compromised, as judged by the Mechanical Engineer, the contractor shall modify the installation as directed by the Engineer at the Contractors expense.
- D. It is the responsibility of this division to install terminal boxes, valves and all other equipment and devices so they can be accessed. If any equipment or devices are installed so they cannot be

- accessed on a ladder a catwalk and ladder system shall be installed above the ceiling to access and service this equipment.
- E. Fans with 3 HP and above, which are elevated such that the distance from floor to any maintenance point is 6-feet or higher, shall have an appropriate access platform with permanent ladders or steps designed and shown on the design drawings.

1.26 CONCRETE BASES AND INSERTS

- A. Bases: The concrete bases shall be provided and installed as work by this division. This Division shall be responsible for the proper size and location of bases and shall furnish all required anchor bolts and sleeves with templates to be installed as work of Division 03, Concrete.
- B. All floor-mounted mechanical equipment shall be set on 6-inch high concrete bases, unless otherwise noted or shown on drawings. Such bases shall extend 6 inches beyond equipment or mounting rails on all sides or as shown on the drawings and shall have a 1-inch beveled edge all around.
- C. Inserts: Where slotted or other types of inserts required for this work are to be cast into concrete, they shall be furnished as work of this Division
- D. Concrete inserts and pipe support systems shall be equal to Unistrut P3200 series for all piping where more than one pipe is suspended at a common location. Spacing of the inserts shall match the size and type of pipe and of ductwork being supported. The Unistrut insert and pipe support system shall include all inserts, vertical supports, horizontal support members, clamps, hangers, rollers, bolts, nuts, and any other accessory items for a complete pipe-supporting system.

1.27 CLEANING AND PAINTING

- A. Cleaning: After all tests and adjustments have been made and all systems pronounced satisfactory for permanent operation, this Contractor shall clean all exposed piping, ductwork, insulated members, fixture, and equipment installed under this Section and leave them ready for painting. He shall refinish any damaged finish and leave everything in proper working order. The Contractor shall remove all stains or grease marks on walls, floors, glass, hardware, fixtures, or elsewhere, caused by his workman or for which he is responsible. He shall remove all stickers on plumbing fixtures, do all required patching up and repair all work of others damaged by this division of the work, and leave the premises in a clean and orderly condition.
- B. Painting: Painting of exposed pipe, insulated pipe, ducts, or equipment is work of Division 09, Exterior and Interior Painting.
- C. Mechanical Contractor: All equipment which is to be furnished in factory prefinished conditions by the mechanical Contractor shall be left without mark, scratch, or impairment to finish upon completion of job. Any necessary refinishing to match original shall be done. Do not paint over nameplates, serial numbers, or other identifying marks.
- D. Removal of Debris, Etc: Upon completion of this division of the work, remove all surplus material and rubbish resulting from this work, and leave the premises in a clean and orderly condition.

1.28 CONTRACT COMPLETION

A. Incomplete and Unacceptable Work: If additional site visits or design work is required by the Engineer or Architect because of the use of incomplete or unacceptable work by the Contractor, then the Contractor shall reimburse the Engineer and Architect for all additional time and expenses involved.

- B. Maintenance Instructions: The Contractor shall furnish the Owner complete printed and illustrated operating and maintenance instructions covering all units of mechanical equipment, together with parts lists.
- C. Instructions To Owner's Representatives: In addition to any detailed instructions called for, the mechanical Contractor must provide, without expense to the Owner, competent instructors to train the Owner's representatives who will be in charge of the apparatus and equipment, in the care, adjustment, and operation of all parts on the heating, air conditioning, ventilating, plumbing, fire protection, and automatic temperature control equipment. Instruction dates shall be scheduled at time of final inspection. A written report specifying times, dates, and name of personnel instructed shall be forwarded to the Architect. A minimum of four 8-hour instruction periods shall be provided. The instruction periods will be broken down to shorter periods when requested by the Owner. The total instruction hours shall not reduced. The ATC Contractor shall provide 4 hours of instructions. The remaining hours shall be divided between the mechanical and sheet metal Contractor.
- D. Guarantee: By the acceptance of any contract award for the work herein described or shown on the drawings, the Contractor assumes the full responsibility imposed by the guarantee as set forth herein and in the General Conditions, and should protect himself through proper guarantees from equipment and special equipment Contractors and from subcontractors as their interests may appear.
- E. The guarantee so assumed by the Contractor and as work of this Section is as follows:
 - 1. That the entire mechanical system, including plumbing, heating, and air-conditioning system shall be quiet in operation.
 - 2. That the circulation of water shall be complete and even.
 - 3. That all pipes, conduit, and connections shall be perfectly free from foreign matter and pockets and that all other obstructions to the free passage of air, water, liquid, sewage, and vent shall be removed.
 - 4. That he shall make promptly and free of charge, upon notice from the Owner, any necessary repairs due to defective workmanship or materials that may occur during a period of one year from date of Substantial Completion.
 - 5. That all specialties, mechanical, and patent devices incorporated in these systems shall be adjusted in a manner that each shall develop its maximum efficiency in the operation of the system; i.e., diffusers shall deliver the designed amount of air shown on drawings, thermostats shall operate to the specified limits, etc.
 - 6. All equipment and the complete mechanical, ductwork, piping and plumbing systems shall be guaranteed for a period of one year from the date of the Architect's Certificate of Substantial Completion, this includes all mechanical, ductwork, piping and plumbing equipment and products and is not limited to boiler, chillers, coils, fans, filters etc. Any equipment supplier not willing to comply with this guarantee period shall not submit a bid price for this project. The Contractor shall be responsible for a 100-percent guarantee for the system and all items of equipment for this period. If the contractor needs to provide temporary heating or cooling to the building and or needs to insure systems are installed properly and or to meet the project schedule the guaranteed of all systems and equipment shall be as indicated above, on year from the date of the Architect's Certificate of Substantial Completion.
 - 7. All filters used during construction shall be replaced just before equipment is turned over to the Owner, and all required equipment and parts shall be oiled. Any worn parts shall also be replaced.
 - 8. If any systems or equipment is used for temporary heating or cooling the systems shall be protected so they remain clean. I.e. if the ductwork systems are used temporary filters and a filter holder (not duct-taped to ducts or grilles) shall be installed to insure the systems and the equipment remain clean.

1.29 CURBS

A. Unless otherwise noted in these specifications or on the documents all roof curbs for all equipment are to be provided by Division 22 and 23.

1.30 TEST RUN

A. The Mechanical Contractor shall operate the mechanical system for a minimum of 30 days to prove the operation of the system.

1.31 EQUIPMENT STARTUP AND CHECKOUT:

- A. Each major piece of equipment shall be started and checked out by an authorized representative of the equipment manufacturer. A certificate indicating the equipment is operating to the satisfaction of the manufacturer shall be provided and shall be included in the commissioning report.
- B. This contractor shall coordinate commissioning procedures and activities with the commissioning agent.

1.32 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:
- B. Proceed with demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
- C. 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.
- D. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
- E. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
- F. Maintain adequate ventilation when using cutting torches.
- G. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
- H. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
- I. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- J. Dispose of demolished items and materials promptly.
- K. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.
- L. Existing Facilities: Comply with building manager's requirements for using and protecting elevators, stairs, walkways, loading docks, building entries, and other building facilities during selective demolition operations.
- M. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.

- N. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- O. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
- P. Air-Conditioning Equipment: Remove equipment without releasing refrigerants.

END OF SECTION

SECTION 23 0500

COMMON WORK RESULTS 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. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - Sleeves.
 - 6. Escutcheons.
 - 7. Grout.
 - 8. Equipment installation requirements common to equipment sections.
 - 9. Painting and finishing.
 - 10. Concrete bases.
 - 11. Supports and anchorages.
 - 12. Link-Seal

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, and crawlspaces.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces, mechanical equipment rooms, accessible pipe shafts, accessible plumbing chases, and accessible tunnels.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. CPVC: Chlorinated polyvinyl chloride plastic.
 - 2. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:

- 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
- 2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Transition fittings.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - Escutcheons.
- B. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. 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 maximum thickness unless thickness or specific material is 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.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, 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, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
 - 1. Use of flux is required in all brazing applications. The flux used is to be a black brazing flux that does not contain boric acid and conforms to AWS A5.31 class FB3-C.
- F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Manufacturers:

- Eslon Thermoplastics.
- B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Manufacturers:
 - a. Thompson Plastics, Inc.

2.5 DIELECTRIC FITTINGS

- A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
- B. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.
- C. Insulating Material: Suitable for system fluid, pressure, and temperature.
- D. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- E. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- F. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig minimum working pressure as required to suit system pressures.
- G. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- H. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Watts Industries, Inc.; Water Products Div

2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Manufacturers:
 - 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 pipe. Include type and number required for pipe material and size of pipe.
- 3. Pressure Plates: Stainless steel. Include two for each sealing element.
- 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.

2.8 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated and rough brass.
- D. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- E. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.

2.9 GROUT

- A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.10 LINK-SEAL MODULAR SEAL PRESSURE PLATES

- A. Link-Seal® modular seal pressure plates shall be molded of glass reinforced Nylon Polymer with the following properties:
 - 1. Izod Impact Notched = 2.05ft-lb/in. per ASTM D-256
 - 2. Flexural Strength @ Yield = 30,750 psi per ASTM D-790
 - 3. Flexural Modulus = 1,124,000 psi per ASTM D-790
 - 4. Elongation Break = 11.07% per ASTM D-638
 - Specific Gravity = 1.38 per ASTM D-792
- B. Models LS200-275-300-315 shall incorporate the most current Link-Seal® Modular Seal design modifications and shall include an integrally molded compression assist boss on the top (bolt entry side) of the pressure plate, which permits increased compressive loading of the rubber sealing element. Models 315-325-340-360-400-410-425-475-500-525-575-600 shall incorporate an integral recess known as a "Hex Nut Interlock" designed to accommodate commercially available fasteners to insure proper thread engagement for the class and service of metal hardware. All pressure plates shall have a permanent identification of the manufacturer's name molded into it.
- C. For fire service, pressure plates shall be steel with 2-part Zinc Dichromate Coating.
- D. Link-Seal® Modular Seal Hardware: All fasteners shall be sized according to latest Link-Seal® modular seal technical data. Bolts, flange hex nuts shall be:
 - 1. 316 Stainless Steel per ASTM F593-95, with a 85,000 psi average tensile strength.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. 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.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.

- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, castbrass type with polished chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
 - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
- M. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. PVC Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- O. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.

- 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- R. Verify final equipment locations for roughing-in.
- S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. 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.
- E. 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 & a black brazing flux that does not contain boric acid complying with AWS A5.31 class FB3-C.
- F. 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.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PIPING CONNECTIONS

- A. 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. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

- A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.8 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

3.9 LINK SEAL

A. Provide Link Seal at all piping penetrations from the outside.

END OF SECTION

SECTION 23 0523

GENERAL-DUTY VALVES FOR HVAC 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.Bronze ball valves.
- 2. Iron, single-flange butterfly valves.
- 3. Bronze lift check valves.
- 4. Bronze swing check valves.
- 5. Iron swing check valves.
- 8. Bronze globe valves.
- 9. Iron globe valves.
- 10. Lubricated plug valves.
- 11. Chainwheels.
- 12. High-performance butterfly valves.

B. Related Sections:

 Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve indicated. Body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and

- arrangement, dimensions and required clearances, and installation instructions. Include list indicating valve and its application.
- B. Maintenance data for valves to be included in the operation and maintenance data specified in Division 1. Include detailed manufacturer's instructions on adjusting, servicing, disassembling, and repairing.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve as listed in SUMMARY from a single source and from a single manufacturer.
- B. Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.
 - 3. ASME B31.9 for building services piping valves.
 - 4. MSS Compliance: Comply with the various MSS Standard Practice documents referenced.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, and weld ends.
 - 3. Set angle, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to HVAC valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.

- 2. Handwheel: For valves other than quarter-turn types.
- 3. Handlever: For quarter-turn valves NPS 6 and smaller[except plug valves].
- 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug-valve head.
- 5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 3. Butterfly Valves: With extended neck.

F. Valve-End Connections:

- 1. Flanged: With flanges according to ASME B16.1 for iron valves.
- 2. Solder Joint: With sockets according to ASME B16.18.
 - Caution: Where soldered end connections are used, use solder having a melting point below 840 deg. For, globe, and check valves: below 421 deg. F for ball valves.
- 3. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
 - 1. APCO Willamette Valve and Primer Corp.
 - 2. Babbitt Steam Specialty Company.
 - 3. Bray Controls.
 - 4. Center Line.
 - 5. Cla-Val Company.
 - 6. Crane Co.; Crane Valve Group.
 - 7. Fisher Valve by Emerson.
 - 8. Flo Fab Inc.
 - 9. Flow-Tek Inc.
 - 10. Grinnell Corporation.
 - 11. Hammond Valve.
 - 12. Jamesbury; a subsidiary of Metso Automation.
 - 13. Jomar International LTD.
 - 14. Keystone Valve USA, Inc.
 - 15. Kitz Corp.
 - 16. Metraflex Company.
 - 17. Milwaukee Valve Company.
 - 18. Mueller Steam Specialty.
 - 19. NIBCO Inc.
 - 20. Red-White Valve Corp.
 - 21. Spence Strainers International.
 - 22. Stockham Valves and Fittings, Inc.
 - 23. Tyco Fire/Shurjoint Piping Products.
 - 24. Tyco/Pentair LTD.
 - 25. Val-Matic Valve & Mfg. Corp.
 - 26. Victaulic Company.
 - 27. Watts Regulator Company.

2.4 BRONZE BALL VALVES

- C. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
 - 1. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

2.5 IRON, SINGLE-FLANGE BUTTERFLY VALVES

- A. 150 CWP, Iron, Single-Flange (Lug) Butterfly Valves:
 - 1. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 150 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Nylon 11 coated ductile iron.
- B. 175 CWP, Iron, Single-Flange (Lug) Butterfly Valves:
 - 1. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 175 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Nylon 11 coated ductile iron.
- C. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Nylon 11 coated ductile Iron Disc:
 - 1. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Nylon 11 coated ductile iron.

- D. 250 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Nylon 11 coated ductile Iron Disc:
 - 1. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 250 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Nylon 11 coated ductile iron.

2.6 BRONZE LIFT CHECK VALVES

- A. Class 125, Lift Check Valve:
 - 1. Description:
 - a. Standard: MSS SP-80.b. CWP Rating: 200 psig.c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 61, ASTM B 62, bronze.
 - e. Ends: Threaded.f. Disc: Bronze, Type 1.

2.7 BRONZE SWING CHECK VALVES

- A. Class 150, Bronze Swing Check Valves with Bronze Disc:
 - 1. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

2.8 IRON SWING CHECK VALVES

- A. Class 125, Iron Swing Check Valves with Metal Seats:
 - 1. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.

2.9 BRONZE GLOBE VALVES

- A. Class 150, Bronze Globe Valves with Nonmetallic Disc:
 - 1. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.e. Stem: Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Teflon impregnated, asbestos free.
 - h. Handwheel: Malleable iron.

2.10 IRON GLOBE VALVES

- A. Class 125, Iron Globe Valves:
 - 1. Description:
 - a. Standard: MSS SP-85, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Stem: Brass alloy. OS &Y.
 - f. Disc: Renewable bronze seat.
 - g. Trim: Bronze.
 - h. Packing and Gasket: Teflon impregnated, asbestos free.
 - i. Handwheel: Cast iron

2.11 LUBRICATED PLUG VALVES

- A. Class 125, Regular-Gland, Lubricated Plug Valves with Threaded Ends:
 - 1. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. Pattern: Regular or short.
 - d. Body Material: ASTM A 48 or ASTM A 126, cast iron with lubrication-sealing system.
 - e. Plug: Cast iron or bronze with sealant groove.

2.12 CHAINWHEELS

- A. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
 - 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 - 2. Attachment: For connection to [ball] [butterfly] [and] [plug] valve stems.
 - 3. Sprocket Rim with Chain Guides: Ductile or cast iron, of type and size required for valve. Include zinc coating.
 - 4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

2.13 HIGH-PERFORMANCE BUTTERFLY VALVES

- A. Class 300, Single-Flange, High-Performance Butterfly Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
 - b. Bray Controls; a division of Bray International.
 - c. Cooper Cameron Valves; a division of Cooper Cameron Corp.
 - d. Crane Co.; Crane Valve Group; Flowseal.
 - e. Crane Co.; Crane Valve Group; Stockham Division.
 - f. DeZurik Water Controls.
 - g. Hammond Valve.
 - h. Jamesbury; a subsidiary of Metso Automation.
 - i. Milwaukee Valve Company.
 - j. NIBCO INC.
 - k. Process Development & Control, Inc.
 - I. Tyco Valves & Controls; a unit of Tyco Flow Control.
 - m. Xomox Corporation.

2. Description:

- a. Standard: MSS SP-68.
- b. CWP Rating: 720 psig at 100 deg F.
- c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
- d. Body Material: Carbon steel, cast iron, or ductile iron.
- e. Seat: Reinforced PTFE or metal.
- f. Stem: Stainless steel; offset from seat plane.
- g. Disc: Carbon steel.
- h. Service: Bidirectional.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine piping system for compliance3 with requirements for installation tolerances and other conditions affecting performance of valves. Do no proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- F. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves as indicated, according to manufacturer's written instructions.
- B. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.
- C. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- D. Locate valves for easy access and provide separate support where necessary.
- E. Install valves in horizontal piping with stem at or above center of pipe.
- F. Install valves in position to allow full stem movement.
- G. Install chainwheels on operators for ball, butterfly globe and plug valves NPS 4 and larger and more than 96 inches above floor.
- H. Extend the chainwheels for chains to 60 inches above finished floor.
- I. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.
 - 4. Install all check valves a minimum of five pipe diameters downstream of pump discharge or elbow to avoid flow turbulence. In extreme cases add flow straighteners as required to correct the turbulence.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball or butterfly valves.
 - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 - 3. Throttling Service except Steam: Globe valves.
 - 4. Throttling Service, Steam: Globe valves.
 - 5. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
 - b. NPS 2-1/2 and Larger: Iron swing check valves with lever and weight or with spring or iron, metal-seat check valves.
 - 6. Drain Service (except Steam): Two-Piece, Full Port Bronze Ball Valves with Bronze Trim. To be installed with NPS ¾ hose thread outlet and hose cap with chain.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:

- 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valveend option is indicated in valve schedules below.
- 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valveend option is indicated in valve schedules below.
- 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
- 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
- 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
- 6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.5 CHILLED-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

- 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
- 3. Ball Valves:
 - a. Piece: Two
 - b. Port: Full.
 - c. Material/Trim: Bronze with:
 - 1) Bronze trim.
- 4. Bronze Swing Check Valves:
 - a. Class 150
 - b. Bronze disc.
- 6. Bronze Globe Valves:
 - a. Class 125
 - b. Bronze disc.

B. Pipe NPS 2-1/2 and Larger:

- 1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
- 2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12:
 - a. 200 CWP,
 - b. Seat: EPDM.
 - c. Disc: Ductile-iron.
- 3. Iron Swing Check Valves: Class 125, metal seats.
- 4. Iron Globe Valves: Class 125.
- 5. Lubricated Plug Valves: Class 125, regular gland, flanged.

3.6 CONDENSER-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

- 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
- Ball Valves:
 - a. Piece: Two
 - b. Port: Full.
 - c. Material/Trim: Bronze with:
 - 1) Bronze trim.
- 4. Bronze Swing Check Valves:
 - a. Class 150
 - b. Bronze disc.
- 6. Bronze Globe Valves:
 - a. Class 125
 - b. Bronze disc.
- B. Pipe NPS 2-1/2 and Larger:

- 1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
- 2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12:
 - a. 200 CWP,
 - b. Seat: EPDM.
 - c. Disc: Ductile-iron.
- 3. Iron Swing Check Valves: Class 125, metal seats.
- 4. Iron Swing Check Valves with Closure Control, NPS 2-1/2 to NPS 12: Class 125, lever and spring.
- 6. Iron Globe Valves: Class 125.
- 7. Lubricated Plug Valves: Class 125, regular gland, flanged.

3.7 HEATING-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 - 3. Ball Valves:
 - a. Piece: Two
 - b. Port: Full.
 - c. Material/Trim: Bronze with:
 - 1) Bronze trim.
 - 4. Bronze Swing Check Valves:
 - a. Class 150
 - b. Bronze disc.
 - 6. Bronze Globe Valves:
 - a. Class 125
 - b. Bronze disc.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
 - 2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12:
 - a. 200 CWP.
 - b. Seat: EPDM.
 - c. Disc: Ductile-iron.
 - 3. Iron Swing Check Valves: Class 125, metal seats.
 - 4. Iron Globe Valves: Class 125.

3.8 LOW-PRESSURE STEAM VALVE SCHEDULE (15 PSIG OR LESS)

- A. Pipe NPS 2 and Smaller:
 - Ball Valves:
 - a. Piece: Two
 - b. Port: Full.
 - c. Material/Trim: Bronze with:
 - 1) Bronze trim.
 - 2. Bronze Swing Check Valves:
 - a. Class 150
 - b. Bronze disc.
 - 4. Bronze Globe Valves:
 - a. Class 125
 - b. Bronze disc.
- B. Pipe NPS 2-1/2 and Larger:

- Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
- 2. Iron Swing Check Valves: Class 125, metal seats.
- 3. Iron Globe Valves: NPS 2-1/2 to NPS 12: Class 125.
- 4. High-Performance Butterfly Valves: Class 300, single flange.

3.9 HIGH-PRESSURE STEAM VALVE SCHEDULE (MORE THAN 15 PSIG)

- A. Pipe NPS 2 and Smaller:
 - 1. Ball Valves:
 - a. Piece: Two
 - b. Port: Full.
 - c. Material/Trim: Bronze with:
 - 1) Bronze trim.
 - 2. Bronze Swing Check Valves:
 - a. Class 150
 - b. Bronze disc.
 - 4. Bronze Globe Valves:
 - Class 125
 - b. Bronze disc.
- B. Pipe Sizes NPS 2-1/2 and Larger:
 - 1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
 - 2. Iron Swing Check Valves: Class 125, metal seats.
 - 3. Iron Globe Valves: NPS 2-1/2 to NPS 12: Class 125.
 - 4. High-Performance Butterfly Valves: Class 300, single flange.

3.10 STEAM-CONDENSATE VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Ball Valves:
 - a. Piece: Two
 - b. Port: Full.
 - c. Material/Trim: Bronze with:
 - 1) Bronze trim.
 - 2. Bronze Swing Check Valves:
 - a. Class 150
 - b. Bronze disc.
 - 4. Bronze Globe Valves:
 - a. Class 125
 - b. Bronze disc.
- B. Pipe NPS 2-1/2 and Larger:
 - Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
 - 2. Iron Swing Check Valves: Class 125, metal seats.
 - 3. Iron Globe Valves: NPS 2-1/2 to NPS 12: Class 125.
 - 4. Lubricated Plug Valves: Class 125, regular gland, flanged.
 - 5. High-Performance Butterfly Valves: Class 300, single flange.

END OF SECTION

SECTION 23 0529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Metal pipe hangers and supports.
- 2. Trapeze pipe hangers.
- 3. Metal framing systems.

B. Related Sections:

- 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
- 2. Division 23 Section "Vibration and Seismic Controls for HVAC" for vibration isolation devices.
- 3. Division 23 Section "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

- A. 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/SEL7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 - 3. Design seismic-restraint hangers and supports for piping and equipment.

1.5 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. Metal framing systems.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

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.

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 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO/Michigan Hanger Co.; ERISTRUT Div.
 - d. GS Metals Corp.
 - e. Hilti, Inc.
 - f. Power-Strut Div. Tyco International.
 - g. Thomas & Betts Corporation.
 - h. Tolco Inc.
 - i. Unistrut; an Atkore International company.
 - 2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
 - 3. Standard: MFMA-4.
 - 4. Channels: Continuous slotted steel channel with inturned lips.
 - 5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 - 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
 - 7. Metallic Coating:
 - a. Electroplated zinc.

B. Non-MFMA Manufacturer Metal Framing Systems:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International; a subsidiary of Mueller Water Products, Inc.
 - b. Empire Industries, Inc.
 - c. ERICO International Corporation.
 - d. Haydon Corporation.
 - e. NIBCO INC.
 - f. PHD Manufacturing, Inc.
 - g. PHS Industries, Inc.
- 2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
- 3. Standard: Comply with MFMA-4.
- 4. Channels: Continuous slotted steel channel with inturned lips.
- 5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
- 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- 7. Coating:
 - a. Zinc.

2.4 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carpenter & Paterson, Inc.
 - 2. Clement Support Services.
 - 3. ERICO International Corporation.
 - 4. National Pipe Hanger Corporation.
 - 5. PHS Industries, Inc.
 - 6. Pipe Shields Inc.
 - 7. Piping Technology & Products, Inc.
 - 8. Rilco Manufacturing Co., Inc.
 - 9. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping:
 - Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength.
- C. Insulation-Insert Material for Hot Piping:
 - 1. Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 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] [stainless-] 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.

2.6 MISCELLANEOUS MATERIALS

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

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices in Section 230548 "Vibration and Seismic Controls for HVAC."
- B. 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.
- C. 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.
 - 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, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- F. 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.
- G. Install lateral bracing with pipe hangers and supports to prevent swaying.
- H. 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.

- I. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- J. 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.

K. Insulated Piping:

- 1. Attach clamps and spacers to piping.
 - 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 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.
- 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.

3.3 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.

3.4 PAINTING

- A. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.5 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 attachments for general service applications.
- F. Use padded hangers for piping that is subject to scratching.
- G. Use thermal-hanger shield inserts for insulated piping and tubing.
- H. 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 noninsulated 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. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.

- 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
- 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
- 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
- 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
- 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
- Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
- 14. 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.
- 15. 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.
- 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
- 17. 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.
- 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
- 19. 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.
- 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
- 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- I. 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.
- J. 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.
 - 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 - 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 - 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- K. 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. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
- 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
- Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel Ibeams for heavy loads.
- 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
- 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
- 12. 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.
- 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- L. 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.
- M. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 - Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 - 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 - 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 - 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 - 6. 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.
 - 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 - 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

- a. Horizontal (MSS Type 54): Mounted horizontally.
- b. Vertical (MSS Type 55): Mounted vertically.
- c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION

SECTION 23 0548

VIBRATION AND SEISMIC CONTROLS 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 SCOPE

- A. Provide engineered vibration isolation and restraint systems in accordance with the requirements of this section including design, engineering, materials, testing, inspections and reports.
- B. Mechanical equipment with moving parts shall be mounted on or suspended from vibration isolators to reduce the transmission of vibration and mechanically transmitted sound to the building structure.
- C. All mechanical equipment, piping and ductwork shall be restrained as required by Federal, State and Local building codes to preserve the integrity of nonstructural building components during seismic events to minimize hazards to occupants and reduce property damage.

1.3 SUMMARY

- A. This Section includes the following:
 - 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. Air-spring isolators.
 - 11. Restrained-air-spring isolators.
 - 12. Elastomeric hangers.
 - 13. Spring hangers.
 - 14. Snubbers.
 - 15. Restraint channel bracings.
 - Restraint cables.
 - 17. Seismic-restraint accessories.
 - 18. Mechanical anchor bolts.
 - 19. Adhesive anchor bolts.
 - 20. Vibration isolation equipment bases.
 - 21. Restrained isolation roof-curb rails.
 - 22. Certification of seismic restraint designs.
 - 23. Installation supervision.
 - 24. Design of attachment of housekeeping pads.
 - 25. All components requiring IBC compliance and certification.
 - 26. All inspection and test procedures for components requiring IBC compliance.

- 27. Restraint of all mechanical equipment, pipe and ductwork, within, on, or outdoors of the building and entry of services to the building, up to but not including, the utility connection, is part of this Specification.
- 28. Seismic certification of equipment

B. Related Requirements:

- 1. Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for devices for plumbing equipment and systems.
- Division 03 Section "Cast-in-Place Concrete."
- 3. Division 07 Section "Roof Accessories"
- 4. Division 23 Section "Hydronic Piping"

1.4 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. ASCE: American Society of Civil Engineers
- D. Ip: Importance Factor.
- E. ESSENTIAL FACILITIES, (Occupancy Category IV, IBC-2018)
 - 1. Buildings and other structures that are intended to remain operational in the event of extreme environmental loading from flood, wind, snow or earthquakes.

F. LIFE SAFETY

- 1. All systems involved with fire protection, including sprinkler piping, jockey pumps, fire pumps, control panels, service water supply piping, water tanks, fire dampers, smoke exhaust systems and fire alarm panels.
- 2. All mechanical, electrical, plumbing or fire protection systems that support the operation of, or are connected to, emergency power equipment, including all lighting, generators, transfer switches and transformers.
- 3. All medical and life support systems.
- 4. Hospital heating systems and air conditioning systems for maintaining normal ambient temperature.
- 5. Automated supply, exhaust, fresh air and relief air systems on emergency control sequence, including air handlers, duct, dampers, etc., or manually-operated systems used for smoke evacuation, purge or fresh air relief by the fire department.
- 6. Heating systems in any facility with Occupancy Category IV, IBC-2018 where the ambient temperature can fall below 32 degrees Fahrenheit.

G. HIGH HAZARD

 All gases or fluids that must be contained in a closed system which are flammable or combustible. Any gas that poses a health hazard if released into the environment and vented Fuel Cells.

1.5 REFERENCE CODES AND STANDARDS

- A. Codes and Standards: The following shall apply and conform to good engineering practices unless otherwise directed by the Federal, State or Local authorities having jurisdiction.
 - 1. IBC
 - ASCE 7
 - 3. NFPA 13 (National Fire Protection Association)
 - 4. IBC 2018
- B. The following guides may be used for supplemental information on typical seismic installation practices. Where a conflict exists between the guides and these construction documents, the construction documents will preside.
 - 1. FEMA (Federal Emergency Management Agency) manuals 412, Installing Seismic Restraints for Mechanical Equipment and 414, Installing Seismic Restraints for Ductwork and Pipe.
 - 2. SMACNA (Sheet Metal and Air-conditioning Contractors' National Association) Seismic Restraint Manual Guidelines for Mechanical Systems, 3rd ed.
 - ASHRAE (American Society for Heating, Refrigerating and Air-conditioning Engineers) A
 Practical Guide to Seismic Restraint
 - 4. MSS (Manufacturers Standardization Society of the Valve and Fittings Industry) MSS SP-127, Bracing for Piping Systems, Seismic – Wind – Dynamic, Design, Selection, Application.

1.6 ISOLATOR AND RESTRAINT MANUFACTURER'S RESPONSIBILITIES:

- A. Provide project specific vibration isolation and seismic restraint design prepared by a registered design professional in the state were the project is being constructed, and manufacturer certifications that the components are seismically qualified.
 - Provide calculations to determine restraint loads resulting from seismic forces as required by IBC, Chapter 16 and ASCE 7, latest editions. Seismic calculations shall be certified by an engineer licensed in the state where the project is being constructed.
- B. Provide installation instructions and shop drawings for all materials supplied under this section of the specifications.
 - 1. Provide seismic restraint details with specific information relating to the materials, type, size, and locations of anchorages; materials used for bracing; attachment requirements of bracing to structure and component; and locations of transverse and longitudinal sway bracing and rod stiffeners.
 - 2. Provide seismic bracing layout drawings indicating the location of all seismic restraints.
 - a. Each piece of rotating isolated equipment shall be tagged to clearly identify quantity and size of vibration isolators and seismic restraints.
- C. Provide, in writing, the special inspection requirements for all Designated Seismic Systems as indicated in Chapter 17 of the IBC.
- D. Provide training for installation, operation and maintenance of isolation and restraint systems.

1.7 PERFORMANCE REQUIREMENTS

- A. Wind-Restraint Loading: Per the structural drawings and specifications.
- B. Flood-Restraint Loading: Per the structural drawings and specifications.
- C. Seismic-Restraint Loading:
 - 1. Site Class as Defined in the IBC: Per the structural drawings and specifications. See structural general notes drawing S-001.
 - 2. Assigned Occupancy Category as Defined in the IBC: Per the structural drawings and specifications.
 - a. Component Importance Factor: 1.5.
 - 1) Life safety components required to function after an earthquake.
 - 2) Components containing hazardous or flammable materials in quantities that exceed the exempted amounts for an open system listed in Chapter 4.
 - 3) For structures with an Occupancy Category IV, components needed for continued operation of the facility or whose failure could impair the continued operation of the facility.
 - 4) Storage racks in occupancies open to the general public (e.g., warehouse retail stores).
 - b. Component Importance Factor: 1.0.
 - 1) All other components
 - c. Component Response Modification Factor: Per the structural drawings and specifications.
 - d. Component Amplification Factor: Per the structural drawings and specifications.
 - 3. Design Spectral Response Acceleration at Short Periods: Per the structural drawings and specifications.
 - 4. Design Spectral Response Acceleration at 1-Second Period: Per the structural drawings and specifications.

1.8 ACTION SUBMITTALS

- A. Product Data: For the following:
 - Submittals shall include catalog cut sheets and installation instructions for each type of anchor and seismic restraint used on equipment or components being isolated and/or restrained.
 - 2. Submittals for mountings and hangers incorporating springs shall include spring diameter and free height, rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 3. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
 - 4. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Shop Drawings:
 - 1. Detail fabrication and assembly of equipment bases. 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 vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. "Basis for Design" report: Statement from the registered design professional that the design complies with the requirements of the ASCE 7-05 Chapter 13, IBC 2052 chapter 1912 and ACI 318. In addition, the basis for compliance must also be noted, as listed below:
 - a. Project specific design documentation prepared and submitted by a registered design professional (ASCE 7, 13.2.1.1)
 - b. Submittal of the manufacturer's certification that the isolation equipment is seismically qualified by:
 - c. An engineered analysis conforming to the requirements of Chapter 13 of ASCE 7.
 - d. Testing by a nationally recognized testing standard procedure such as ICC-ES AC 156. The substantiated seismic design capacities shall exceed the seismic demands determined by Section 13.3 of ASCE 7.
 - e. Experience data conforming to a nationally recognized procedure. The substantiated seismic design capacities shall exceed the seismic demands determined by Section 13.3 of ASCE 7.
 - 2. Seismic restraint load ratings must be certified and substantiated by testing or calculations under direct control of a registered professional engineer. Copies of testing and calculations must be submitted as part of submittal documents.
 - Include design calculations and details for selecting vibration isolators, seismic restraints, and vibration isolation bases complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 4. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.
 - Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Division 23 Sections for equipment mounted outdoors.
 - 5. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
 - 6. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
 - 7. Seismic-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.9 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.
 - 1. Submittal drawings and calculations must be stamped by a registered professional engineer in the State where the project is being constructed who is responsible for the seismic restraint design.
 - Calculations and restraint device submittal drawings shall specify anchor bolt type, embedment, concrete compressive strength, minimum spacing between anchors, and minimum distances of anchors from concrete edges. Concrete anchor locations shall not be near edges, stress joints, or an existing fracture. All bolts shall be ASTM A307 or better.
- B. Qualification Data: For professional engineer and testing agency.
- C. Welding certificates.
- D. Field quality-control test reports.

1.10 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage 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 not available, 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.

1.11 SEISMIC CERTIFICATION OF EQUIPMENT

- A. Component Importance Factor. All plumbing and mechanical components shall be assigned a component importance factor. The component importance factor, Ip, shall be taken as 1.5 if any of the following conditions apply:
 - 1. The component is required to function for life-safety purposes after an earthquake.
 - 2. The component contains hazardous materials.
 - 3. The component is in or attached to an Occupancy Category IV structure and it is needed for continued operation of the facility or its failure could impair the continued operation of the facility.
- B. All other components shall be assigned a component importance factor, Ip, equal to 1.0.
- C. For equipment or components where Ip = 1.0.

- 1. Submit manufacturer's certification that the equipment is seismically qualified by:
 - a. An engineered analysis conforming to the requirements of Chapter 13 of ASCE 7.
 - b. Testing by a nationally recognized testing standard procedure such as ICC-ES AC 156. The substantiated seismic design capacities shall exceed the seismic demands determined by Section 13.3 of ASCE 7.
 - c. Experience data conforming to a nationally recognized procedure. The substantiated seismic design capacities shall exceed the seismic demands determined by Section 13.3 of ASCE 7.
- 2. The equipment and components listed below are considered rugged and shall not require Special Seismic Certification:
 - a. Valves (not in cast-iron housings, except for ductile cast iron).
 - b. Pneumatic operators.
 - c. Hydraulic operators.
 - d. Motors and motor operators.
 - e. Horizontal and vertical pumps (including vacuum pumps).
 - f. Air compressors
 - g. Refrigerators and freezers.
 - h. Elevator cabs.
 - i. Underground tanks.
 - j. Equipment and components weighing not more than 20 lbs. supported directly on structures (and not mounted on other equipment or components) with supports and attachments in accordance with Chapter 13, ASCE 7.
- 3. Rugged equipment and components in this section are for factory assembled discrete equipment and components only and do not apply to site assembled or field assembled equipment or equipment anchorage.
- D. Special Certification requirements for Designated Seismic Systems (i.e. Ip = 1.5): Seismic Certificates of Compliance supplied by manufacturers shall be submitted for all components that are part of Designated Seismic Systems. In accordance with the ASCE 7, certification shall be via one of the following methods:
 - 1. For active mechanical and electrical equipment that must remain operable following the design earthquake:
 - a. Testing as detailed by part C.1.b above.
 - b. Experience data as detailed by part C.1.c above.
 - c. Equipment that is considered "rugged" per part C.2 above.
 - 2. Components with hazardous contents shall be certified by the manufacturer as maintaining containment following the design earthquake by:
 - a. Testing as detailed by part C.1.b above.
 - b. Experience data as detailed by part C.1.c above.
 - c. Engineering analysis utilizing dynamic characteristics and forces. Tanks (without vibration isolators) designed by a registered design professional in accordance with ASME Boiler and Pressure Vessel Code, and satisfying the force and displacement requirements of Sections 13.3.1 and 13.3.2 of ASCE 7 having an importance factor, Ip = 1.0 shall be considered to satisfy the Special Seismic Certification requirements on the basis of ASCE 7 Section 13.6.9.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. CalDyn (California Dynamics Corporation).
 - 3. ISAT (International Seismic Application Technology).
 - 4. Kinetics Noise Control.
 - 5. Mason Industries.
 - 6. Vibro-Acoustics
 - 7. VMC (Vibration Mountings & Controls, Inc.)

B. Elastomeric Isolation Pads P1:

- 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.
- Surface Pattern: Ribbed pattern.
- 5. Load-bearing metal plates adhered to pads.
- C. Double-Deflection, Elastomeric Isolation Mounts M1:
 - 1. Mounting Plates:
 - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded or with threaded study 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.
- D. Restrained Elastomeric Isolation Mounts M2:
 - 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.
- E. Spring Isolators S1: 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.
 - Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch-thick, rubber isolator pad attached to baseplate 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.
- F. Restrained Spring Isolators S2: Freestanding, steel, open-spring isolators with seismic or limitstop restraint.
 - 1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch-thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation. Baseplates shall limit floor load to 500 psig.
 - 2. Restraint: Seismic or limit stop as required for equipment and authorities having iurisdiction.
 - 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.
- G. Housed Restrained Spring Isolators S3: 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.
 - 6. Elastomeric pad: For high frequency absorption at the base of the spring.
- H. Elastomeric Hangers H1:
 - Description: Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods
 - a. 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.
 - b. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.
- I. Spring Hangers H2: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
 - 1. Description: Combination Coil-Spring and Elastomeric-Insert Hanger with spring and Insert in Compression.

- a. 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.
- b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
- c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
- d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
- e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- f. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
- g. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- J. Spring Hangers with Vertical-Limit Stop H3: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
 - 1. Description: Combination Coil-Spring and Elastomeric-Insert Hanger with spring and insert in Compression and vertical limit stop.
 - a. 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.
 - b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - f. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 - g. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 - h. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

K. Pipe Riser Resilient Support R1:

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

L. Resilient Pipe Guides R2:

- 1. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch-thick neoprene.
 - a. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.
- M. Horizontal Thrust Restraints T1: Modified specification S2 isolator.
 - 1. Horizontal thrust restraints shall consist of a modified specification S2 spring mounting. Restraint springs shall have the same deflection as the isolator springs.

- 2. The assembly shall be preset at the factory and fine tuned in the field to allow for a maximum of 1/4" movement from stop to maximum thrust.
- 3. The assemblies shall be furnished with rod and angle brackets for attachment to both the equipment and duct work or the equipment and the structure.
- 4. Restraints shall be attached at the center line of thrust and symmetrically on both sides of the unit.

2.2 RESTRAINED VIBRATION ISOLATION ROOF-CURB RAILS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. CalDyn (California Dynamics Corporation).
 - 3. ISAT (International Seismic Application Technology).
 - 4. Kinetics Noise Control.
 - 5. Mason Industries.
 - Vibro-Acoustics
 - 7. VMC (Vibration Mountings & Controls, Inc.)
- B. Restrained Vibration Isolation Roof-Curb Rails: RC1:
- C. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand seismic and wind forces.
- D. Upper Frame: The upper frame shall provide continuous support for equipment and shall be captive to resiliently resist seismic forces.
- E. Lower Support Assembly: The lower support assembly shall be a formed sheet-metal section containing adjustable and removable steel springs that support upper frame. Lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2 inches of rigid, glass-fiber insulation on inside of assembly.
- F. Spring Isolators: Adjustable, restrained spring isolators shall be mounted on 1/4-inch-thick, elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.
 - Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic and wind restraint.
 - a. Housing: Steel with resilient vertical-limit stops and adjustable equipment mounting and leveling bolt.
 - Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- G. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch-thick.
- H. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counter flashed over roof materials.

2.3 VIBRATION ISOLATION EQUIPMENT BASES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. CalDyn (California Dynamics Corporation).
 - 3. ISAT (International Seismic Application Technology).
 - Kinetics Noise Control.
 - Mason Industries.
 - 6. Vibro-Acoustics
 - 7. VMC (Vibration Mountings & Controls, Inc.)
- B. Steel Bases and Rails SB1: Factory-fabricated, welded, structural-steel bases and rails.
 - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 - 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- C. Inertia Base IB1: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
 - 1. Design Requirements: Lowest possible mounting height with not less than 2-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 - 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
 - 4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.4 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. CalDyn (California Dynamics Corporation).
 - 3. ISAT (International Seismic Application Technology).
 - 4. Kinetics Noise Control.
 - Mason Industries.
 - 6. Vibro-Acoustics
 - 7. VMC (Vibration Mountings & Controls, Inc.)
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES.

- 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. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
 - 1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 - 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 - 3. Maximum 1/4-inch air gap, and minimum 1/4-inch-thick resilient cushion.
- D. Channel Support System: MFMA-4, shop- or field-fabricated support 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; and rated in tension, compression, and torsion forces.
- E. Restraint Cables: ASTM A 603 galvanized or ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement. Cables located in exterior or other wet locations such as wash-down areas shall be stainless steel.
- F. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod.
- G. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- H. 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.
- I. 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.
- J. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- K. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- L. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.
- M. All post installed anchors utilized in the seismic design must be qualified for use in cracked concrete and approved for use with seismic loads.
- N. Expansion anchors shall not be used for anchorage of equipment with motors rated over 10 HP with the exception of undercut expansion anchors. Spring or internally isolated equipment are exempt from this requirement.
- O. All beam clamps utilized for vertical support must also incorporate retention straps.

P. All seismic brace arm anchorages to include concrete anchors, beam clamps, truss connections, etc., must be approved for use with seismic loads.

2.5 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and tested equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
 - 3. Baked enamel or powder coat for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation and seismic control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 COORDINATION

- 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 Division 03 Section "Cast-in-Place Concrete."
- B. Coordinate size, shape, reinforcement and attachment of all housekeeping pads supporting vibration/seismically rated equipment. Concrete shall have a minimum compressive strength of 4,000 psi or as specified by the project engineer. Coordinate size, thickness, doweling, and reinforcing of concrete equipment housekeeping pads and piers with vibration isolation and seismic restraint device manufacturer to ensure adequate space, embedment and prevent edge breakout failures. Pads and piers must be adequately doweled in to structural slab.
- C. Housekeeping pads shall have adequate space to mount equipment and seismic restraint devices.
- D. Housekeeping Pads must be adequately reinforced and adequately sized for proper installation of equipment anchors and shall also be large enough and thick enough to ensure adequate edge distance and embedment depth for restraint anchor bolts to avoid housekeeping pad breakout failure. Refer seismic restraint manufacturer's written instructions.
- E. Coordinate with vibration/seismic restraint manufacturer and the structural engineer of record to locate and size structural supports underneath vibration/seismically restrained equipment (e.g. roof curbs, cooling towers and other similar equipment). Installation of all seismic restraint materials specified in this section shall be accomplished as per the manufacturer's written instructions. Adjust isolators and restraints after piping systems have been filled and equipment is at its operating weight, following the manufacturer's written instructions.

3.3 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES and per the seismic restraint manufacturer's design.
- 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 will be adequate to carry present and future static and seismic loads within specified loading limits.

3.4 VIBRATION-CONTROL DEVICE INSTALLATION

- A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- B. Comply with requirements in Division 23 Section "Hydronic Piping" for piping flexible connections.
- C. Isolate all mechanical equipment 0.75 hp and over per the isolator and seismic restraint schedule and these specifications. Vibration isolators shall be selected in accordance with the equipment, pipe or duct weight distribution so as to produce reasonably uniform deflections
- D. All isolation materials and seismic restraints shall be of the same vendor and shall be selected and certified using published or factory certified data
- E. Installation of all vibration isolation materials, flexible connectors and supplemental equipment bases specified in this section shall be accomplished as per the manufacturer's written instructions with mountings adjusted to level equipment. Any variance or non-compliance with the manufacturer's instructions shall be reviewed and approved in writing by the manufacturer or corrected by the contractor in an approved manner.
- F. Installation of vibration isolators must not cause any change of position of equipment, piping or duct work resulting in stresses or misalignment.
- G. Locate isolation hangers as near to the overhead support structure as possible.
- H. No rigid connections between isolated components and the building structure shall be made that degrades the noise and vibration control system herein specified. "Building" includes, but is not limited to, slabs, beams, columns, studs and walls. "Components" includes, but is not limited to, mechanical equipment, piping and ducts.
- I. Coordinate work with other trades to avoid rigid contact with the building.
- J. Any conflicts with other trades which will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions should be brought to the architects/engineers attention prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.
- K. Bring to the architects/engineers attention any discrepancies between the specifications and the field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the responsible contractor's expense.
- L. Correct, at no additional cost, all installations which are deemed defective in workmanship and materials at the contractor's expense.

- M. Use horizontal thrust restraints T1 to protect Air handling equipment and centrifugal fans against excessive displacement which results from high air thrust when thrust forces exceed 10% of the equipment weight.
- N. Isolated equipment, duct and piping located on roofs must be attached to the structure. Supports (e.g., sleepers) that are not attached to the structure will not be acceptable.
- O. On completion of installation of all isolation materials and before startup of isolated equipment all debris shall be cleared from areas surrounding and from beneath all isolated equipment, leaving equipment free to move on the isolation supports.
- P. All floor mounted isolated equipment shall be protected with specification M1, M2, S1, S2 or S3 isolator.
- Q. Horizontal Pipe Isolation: All HVAC pumped water, pumped condensate, glycol, and refrigerant piping size 1-1/4" and larger within mechanical rooms shall be isolated. Outside equipment rooms this piping shall be isolated for the greater of 50' or 100 pipe diameters from rotating equipment. For the first three (3) support locations from externally isolated equipment provide specification H2 or H3 hangers or specification S1, S2 or S3 mounts with the same deflection as equipment isolators (max 2"). All other piping within the equipment rooms shall be isolated with the same specification isolators with a 3/4" minimum deflection. Steam piping size 1-1/4" and larger which is within an equipment room and connected to rotating equipment shall be isolated for three (3) support locations from the equipment. Provide specification H2 or H3 hangers, or specification S1 or S2 mounts with the same deflection as equipment isolators but a minimum of 3/4".
- R. Install full line size flexible pipe connectors at the inlet and outlet of each pump, cooling tower, condenser, chiller, coiling connections and where shown on the drawings. All connectors shall be suitable for use at the temperature, pressure, and service encountered at the point of installation and operation. End fitting connectors shall conform to the pipefitting schedule. Control rods or protective braid must be used to limit elongation to 3/8". Flexible connectors shall not be required for suspended in-line pumps.
- S. All plumbing pumped water, piping size 1-1/4" and larger within mechanical rooms shall be isolated the same as HVAC piping above. Isolators are not required for any plumbing pumped water, pumped condensate, and steam piping outside of mechanical rooms unless listed in the isolation schedule.
- Т. Pipe Riser Isolation: The operating weight of all variable temperature vertical pipe risers 1-1/4" and larger, requiring isolation where specifically shown and detailed on riser drawings shall be fully supported by specification M1, M2 or R1 supports. S1, S2, S3, H2 or H3 steel spring deflection isolators with minimum 3/4-inch minimum shall be in those locations where added deflection is required due to pipe expansion and contraction. Spring deflection shall be a minimum of 4 times the anticipated deflection change. Springs shall be selected to keep the riser in tension. Height saving brackets used with isolators having 2.5" deflection or greater shall be of the precompression type to limit exposed bolt length. Specification R1 riser supports shall be installed near the center point of the riser to anchor the riser when spring isolation is used. Specification R2 riser guides may be used in conjunction with spring isolators per design calculations. Pipe risers up through 16" shall be supported at intervals of every third floor of the building. Pipe risers 18" and over, every second floor. Wall sleeves for take-offs from riser shall be sized for insulation O.D. plus two times the anticipated movement to prevent binding. Horizontal take-offs and at upper and lower elbows shall be supported with spring isolators as required to accommodate anticipated movement. In addition to submittal data requirements previously outlined, riser diagrams and calculations shall be submitted for approval. Calculations must show anticipated expansion and contraction at each support point, initial and final loads on the building structure, and spring deflection changes. Submittal data shall include certification that the riser system has been examined for excessive stresses and that none will exist if installed per design proposed.

- U. Where riser pipes pass through cored holes, core diameters shall be a maximum of 2" larger than pipe O.D. including insulation. Cored holes must be packed with resilient material or firestop as provided by other sections of this specification or local codes. Where seismic restraint is required specification isolator S3 shall support risers and provide longitudinal restraint at floors where thermal expansion is minimal and will not bind isolator restraints.
- V. Duct Isolation: Isolate all duct work with a static pressure 2" W.C. and over in equipment rooms and to minimum of 50 feet from the fan or air handler. Use specification type H2 or H3 hangers or type S1 or S2 floor mounts.

3.5 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:

- 1. On projects with Seismic Site Class A or B, seismic design or restraint is not required.
- 2. On projects with Seismic Design Category C: Components with an importance factor of 1.0 do not require seismic design or restraint.
- 3. 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.
- 4. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
- 5. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.
- 6. Suspended Equipment: All suspended equipment that meets any of the following conditions requires seismic restraints as specified by the supplier:
 - a. Rigidly attached to pipe or duct that is 75 lbs. and greater,
 - Items greater than 20 lbs and distribution systems weighing more than 5 lbs/lineal foot, with an importance factor of 1.0 hung independently or with flexible connections.
 - c. Possibility of consequential damage.
 - d. For importance factors greater than 1.0 all suspended equipment requires seismic restraint regardless of the above notes.
 - e. Wall mounted equipment weighing more than 20 lbs.
 - f. Exemptions:
 - 1) Equipment weighing less than 20 lbs and distribution systems weighing less than 5 lbs/lineal foot, with an Ip = 1.0 and where flexible connections exist between the component and associated ductwork, piping or conduit.
- 7. Base Mounted Equipment: All base mounted equipment that meets any of the following conditions requires attachments and seismic restraints as specified by the supplier:
 - a. Connections to or containing hazardous material,
 - b. With an overturning moment.
 - c. Weight greater than 400 lbs.
 - d. Mounted on a stand 4 ft. or more from the floor
 - e. Possibility of consequential damage.
 - f. For importance factors greater than 1.0 all base mounted items require seismic restraints regardless of the above notes.

- g. For equipment with high center of gravity additional cable restraints shall be furnished, as required by isolation manufacturer, to limit forces and motion caused by rocking.
- h. Exemptions:
 - Floor or curb-mounted equipment weighing less than 400 lbs and not resiliently mounted, where the Importance Factor, Ip = 1.0, the components are mounted at 4 feet or less above a floor level, flexible connections between the components and associated duct work, piping and conduit are provided and there is no possibility of consequential damage.

8. Roof Mounted Equipment:

- a. To be installed on a structural frame, seismically rated roof curb, or structural curb frame mechanically connected to the structure. Items shall not be mounted onto sleepers or pads that are not mechanically and rigidly attached to the structure. Restraint must be adequate to resist both seismic and wind forces.
- b. Roof curbs shall be installed directly to building structural steel or concrete roof deck and not to top of steel deck or roofing material.
- c. Exemptions:
 - 1) Curb-mounted mushroom, exhaust and vent fans with curb area less than nine square feet are excluded.

9. Rigid Mounted Equipment:

- a. Anchor floor and wall mounted equipment to the structure as per the stamped seismic certifications / drawings.
- b. For equipment with high center of gravity additional cable restraints shall be furnished, as required by isolation manufacturer, to limit forces and motion caused by rocking.
- Suspended equipment shall be restrained using seismic cable restraints, or struts, and hanger rods as per the stamped seismic certifications / drawings.

10. Vibration Isolated Equipment:

- a. Seismic control shall not compromise the performance of noise control, vibration isolation or fire stopping systems.
- b. Equipment supported by vibration-isolation hangers shall be detailed and installed with approximately a 1/8" gap between the isolation hangers and the structure. Isolators at restraint locations must be fitted with uplift limit stops.
- B. 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.
- C. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
- D. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.
- E. Installation and adjustment of all seismic restraints specified in this section shall be accomplished as per the manufacturer's written instructions. Any deviation from the manufacturer's instructions shall be reviewed and approved by the manufacturer.

F. Piping Restraints:

- 1. Comply with requirements in MSS SP-127.
- 4. Seismically restrain piping, with an Ip = 1.0, located in boiler rooms, mechanical equipment rooms and refrigeration equipment rooms that is $1\frac{1}{4}$ " I.D. and larger.
- 5. Seismically restrain all other Ip = 1.0 piping $2\frac{1}{2}$ " diameter and larger.

- 6. Seismically restrain all Ip = 1.5 piping larger than 1" diameter.
- 7. Branch lines may not be used to brace main lines.
- 8. Exemptions:
 - a. All high deformability pipe 3" or less in diameter suspended by individual hanger rods where Ip = 1.0.
 - b. High deformability pipe or conduit in Seismic Design Category C, 2" or less in diameter suspended by individual hanger rods where Ip = 1.5.
 - c. High deformability pipe in Seismic Design Category D, E or F, 1" or less in diameter suspended by individual hanger rods where Ip = 1.5.
 - d. All clevis supported pipe runs installed less than 12" from the top of the pipe to the underside of the support point and trapeze supported pipe suspended by hanger rods having a distance less than 12" in length from the underside of the pipe support to the support point of the structure.
 - e. Piping systems, including their supports, designed and constructed in accordance with ASME B31.
 - f. Piping systems, including their supports, designed and constructed in accordance with NFPA, provided they meet the force and displacement requirements of Section 13.3.1 and 13.3.2 (ASCE 7).
- G. Install flexible metal hose loops in piping which crosses building seismic joints, sized for the anticipated amount of movement.
- H. Install flexible piping connectors 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.
- I. Where pipe sizes reduce below dimensions required for seismic, the final restraint shall be installed at the transition location.
- J. Restraint Spacing For Piping: Sizes shown are maximum. Actual spacing determined by calculation.
 - 1. For non-ductile piping (e.g., cast iron, PVC) space transverse supports a maximum of 20' o.c., and longitudinal supports a maximum of 40' o.c.
 - 2. For piping with hazardous material inside (e.g., natural gas, medical gas) space Transverse supports a maximum of 20' o.c., and longitudinal supports a maximum of 40' o.c.
 - 3. For pipe risers, restrain the piping at floor penetrations using the same spacing requirements as above.
 - 4. For all other ductile piping see Table "A" below
- K. Seismic Restraint of Ductwork: Seismically restrain per specific code requirements, all ductwork listed below (unless otherwise indicated on the drawings), using seismic cable restraints: (Ductwork not meeting criteria listed below is to be "Exempt")
 - 1. Restrain rectangular ductwork with cross sectional area of 6 square feet or larger. Duct with and an importance factor of 1.5 must be braced with no exceptions regardless of size or distance requirements.
 - 2. Restrain round ducts with diameters of 28" or larger. Duct with an importance factor of 1.5 must be braced with no exceptions regardless of size or distance requirements.
 - 3. Restrain flat oval ducts the same as rectangular ducts of the same nominal size.
 - 4. Duct must be reinforced at the restraint locations. Reinforcement shall consist of an additional angle on top of the ductwork that is attached to the support hanger rods. Ductwork is to be attached to both upper angle and lower trapeze. Additional reinforcing is not required if duct sections are mechanically fastened together with frame bolts and positively fastened to the duct support suspension system.

- 5. A group of ducts may be combined in a larger frame so that the combined weights and dimensions of the ducts are less than or equal to the maximum weight and dimensions of the duct for which bracing details are selected.
- 6. Walls, including gypsum board non-bearing partitions, which have ducts running through them, may replace a typical transverse brace. Provide channel framing around ducts and solid blocking between the duct and frame.
- 7. If ducts are supported by angles, channels or struts, ducts shall be fastened to it at seismic brace locations in lieu of duct reinforcement.
- 8. All ductwork weighing more than 17 lb/ft.
- 9. Exemptions:
 - a. Duct runs supported at locations by two rods less than 12 inches in length from the structural support to the structural connection to the ductwork. This exemption does not apply to ducts with an importance factor of 1.5.
- 10. See Table "A" below for restraint spacing.
- L. Exemptions do not apply for:
 - 1. Life Safety or High Hazard Components
 - a. Including gas, fire protection, medical gas, fuel oil and compressed air needed for the continued operation of the facility or whose failure could impair the facility's continued operation, Occupancy Category IV, IBC-2018 as listed in Section 1.3 B regardless of governing code for HVAC, Plumbing, Electrical piping or equipment. (A partial list is illustrated.) High Hazard is additionally classified as any system handling flammable, combustible or toxic material. Typical systems not excluded are additionally listed below.

2. Piping

a. Fuel oil, gasoline, natural gas, medical gas, steam, compressed air or any piping containing hazardous, flammable, combustible, toxic or corrosive materials. Fire protection standpipe, risers and mains. Fire Sprinkler Branch Lines must be end tied.

3. Duct

a. Smoke evacuation duct or fresh air make up connected to emergency system, emergency generator exhaust, boiler breeching or as used by the fire department on manual override.

4. Equipment

- a. Previously excluded non life safety duct mounted systems such as fans, variable air volume boxes, heat exchangers and humidifiers having a weight greater than 75 lbs require independent seismic bracing.
- M. Spacing Chart For Suspended Components:

N. Roof mounted duct is to be installed on sleepers or frames mechanically connected to the

Table "A" Seismic Bracing								
(Maximum Allowable Spacing Shown- Actual Spacing to Be Determined by Calculation)								
Equipment	On Center Transverse	On Center Longitudinal	Change Of Direction					
Duct								
All Sizes	30 Feet	60 Feet	4 Feet					
Pipe Threaded, Welded, Soldered Or Grooved								
To 16"	40 Feet	80 Feet	4 Feet					
18" – 28"	30 Feet	60 Feet	4 Feet					
30" – 40"	20 Feet	60 Feet	4 Feet					
42" & Larger	10 Feet	30 Feet	4 Feet					

building structure. Roof anchors and seismic cables or frames shall be used to resist seismic and wind loading. Wind loading factors shall be determined by the registered design professional.

- O. Where duct sizes reduce below dimensions required for seismic restraint the final restraint shall be installed at the transition location.
- P. Install cables so they do not bend across edges of adjacent equipment or building structure.
- Q. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolts and mounting hole in concrete base.
- R. 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.
- S. 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.
- T. Seismically Rated Beam Clamps are required where welding to or penetrations to steel beams are not approved.

U. Drilled-in Anchors:

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

3.6 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 Division 23 Section "Hydronic Piping" for piping flexible connections.

3.7 FIELD QUFALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
 - A representative of the vibration isolation system manufacturer shall review the project installation and provide documentation indicating conformance to vibration isolation design intent
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.
 - 1. The installing contractor shall submit a report upon request to the building architect and/or engineer, including the manufacturer's representative's final report, indicating that all seismic restraint material has been properly installed, or steps that are to be taken by the contractor to properly complete the seismic restraint work as per the specifications.

3.8 IDENTIFICATION

- A. Install identification tags at all seismic brace locations. Tags to include the following information:
 - 1. Specific seismic forces (g-force) the location was designed to resist.
 - 2. Maximum brace reaction at connection to structure.
 - 3. For single hung items, the maximum pipe/conduit size the brace location was designed to accommodate.
 - 4. For trapeze supported items, the maximum weight (lbs/lf) the brace location was designed to accommodate.
 - 5. For suspended equipment, the maximum unit operating weight (lbs) the brace location was designed to accommodate.
 - 6. Location identifier cross matched to that on plan set layout.
 - 7. Company name of installing contractor.

3.9 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust leveling devices as required to distribute loading uniformly on isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.
 - 1. Adjust active height of spring isolators.
- C. 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.

EQUIPMENT ISOLATION SCHEDULE									
	A'			B'			C'		
LOCATION	CRITIC			UPPER STORY				GRADE	
	AL (35'-50' SPAN)			(20'-35' SPAN)					
	ISOLA MINIMILI			ISOL A	MINIMU	,	ISOLA MINIMU DA OF		
	TOR	M	BASE	TOR	M	BASE	TOR	M	BASE
		DEFLE			DEFLE			DEFLE	
	TYPE	CTION	TYPE	TYPE	CTION	TYPE	TYPE	CTION	TYPE
EQUIPMENT (1)		(IN)			(IN)			(IN)	
AIR HANDLING UNITS		, ,			, ,			, ,	
FLOOR MOUNTED									
UP TO 15 HP	S3	1.5		S3	0.75		S3	0.75	
20 HP & OVER	S3	2.5	SB1	S3	1.5		S3	0.75	
SUSPENDED									
UP TO 15 HP	H3	1.75		Н3	1		H3	1	
20 HP & OVER	H3	2.5	SB1	H3	1.75		H3	1	
HIGH PRESSURE FAN									
SECTIONS									
UP TO 30 HP	S1	2.5	IB1	S3	1.5	IB1	S3	0.75	IB1
40 HP & OVER	S1	3.5	IB1	S3	2.5	IB1	S3	1.5	IB1
CENTRIFUGAL FANS									
CL. I & II UP TO <i>54-112"</i> W.D.									
UPT015HP	S3	1.5	SB1	S3	0.75	SB1	S3	0.75	SB1
20-50 HP	S1	2.5	IB1	S3	1.5	IB1	S3	0.75	SB1
60 HP & OVER	S1	3.5	IB1	S1	2.5	IB1	S3	1.5	SB1
CL. I & II 60" W.D. & OVERI									
ALL CL. III FANS	04	0.5	ID4	00	4.5	ID4	00	0.75	ID4
UPT015HP	S1	2.5	IB1	S3	1.5	IB1	S3	0.75	IB1
20-50 H P	S1	2.5	IB1	S1	2.5	IB1	S3	1.5	IB1
60 HP & OVER	S1	3.5	IB1	S1	2.5	IB1	S3	1.5	IB1
AXIAL FLOWFANS FLOOR MTD.									
UP TO 15 HP	S3	1.5	SB1	S3	0.75		S3	0.75	
20 HP & OVER	S1	3.5	IB1	S3	1.5		S3	0.75	
SUSPENDED	31	3.3	וטו	33	1.5		- 55	0.73	
UP TO 15 HP	НЗ	1.75	SB1	Н3	1		НЗ	1	
20 HP & OVER	H3	2.5	SB1	H3	1.75	SB1	H3	1.5	
VENT (UTILITY SETS)			- 55.		0				
FLOOR MTD	S3	1.5	SB1	S3	0.75		S3	0.75	
SUSPENDED	H3	1.75	SB1	H3	1		H3	0.75	
CABINET FANS, FANS									
SECTIONS									
FLOOR MTD.									
UP TO 15 HP	S3	1.5		S3	0.75		S3	0.75	
20 HP & OVER	S1	2.5	IB1	S3	1.5		S3	0.75	
SUSPENDED									
UP TO 15 HP	H3	1.75		Н3	1		H3	0.75	
20 HP & OVER	Н3	2.5	SB1	Н3	1.75		H3	1.75	
PUMPS									
FLOOR MTD.									
UP TO 15 HP	S3	0.75	IB1	S3	0.75	IB1	SRVD	0.4	IB1
7-112 HP & OVER	S3	1.5	IB1	S3	1.5	IB1	S3	0.75	IB1
SUSPENDED INLINE	H3	1.75		H3	1.75		H3	1	
REFRIGERATION UNITS									

RECIPROCATING	S1	0.5	ID4	S3	4.5	ID4	S3	0.75	IB1
COMPRESSORS	51	2.5	IB1	53	1.5	IB1	53	0.75	IBI
RECIPROCATING COND. UNITS & CHILLERS	S1	2.5	IB1	S3	1.5		S3	0.75	
HERMETIC CENTRIFUGALS	S3	2.5		S3	1.5		P1	0.15	
OPEN CENTRIFUGALS	S1	2.5	IB1	S3	1.5	IB1	P1	0.15	
ABSORPTION MACHINES	S3	1.5		S3	0.75		P1	0.15	
AIR COMPRESSORS									
TANK TYPE (HORIZONTAL	S1	2.5	IB1	S3	1.5		S3	0.75	
TANK)	31	2.5	IDI	33	1.5		33	0.75	
TANK TYPE (VERTICAL	S1	2.5	IB1	S3	1.5	IB1	S3	0.75	
TANK)	5	2.5	IDI	3	1.5	ЮТ	3	0.75	
COOLING TOWERS &									
CLOSED CIRCUIT COOLERS									
UP TO 500 TONS	S3	2.5		S3	0.75		P1	0.15	
OVER 500 TONS	S3	4.5		S3	2.5		P1	0.15	
AIR COOLED CONDENSERS									
UP TO 50 TONS	S3	1.5		S3	0.75		P1	0.15	
OVER 50 TONS	S3	2.5		S3	1.5		P1	0.15	
ROOFTOP AIR									
CONDITIONING UNITS									
REQUIRING WEATHER									
SEAL	_			_					
UP TO 5000 CFM (12 TON)	S1	1.5	RC1	S1	0.75	RC1			
OVER 5000 CFM (12 TON)	S3	2.5	RC1	S3	1.5	RC1			
OTHER TYPES									
UP TO 25 TONS	S3	1.5		S3	1.5				
OVER 25 TONS	S3	2.5		S3	1.5				
BOILER (PACKAGE TYPE)									
ALL SIZES	S3	1.5		S3	0.75		P1	0.15	
ENGINE DRIVEN									
GENERATORS				00			0.0		
UP TO 60 HP	S1	2.5	IB1	S3	1.5	IB1	S3	0.75	
75 HP & OVER	S1	3.5	IB1	S3	2.5	IB1	S3	0.75	

NOTES:

END OF SECTION

¹⁾ Thrust restraints required on all high-pressure fan section, suspended axial-flow fans and on floor-mounted axial fans operating at 3.0" S.P. or greater.

SECTION 23 0553

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Equipment labels.
- 2. Danger, Warning and Caution signs and labels.
- 3. Pipe labels.
- 4. Duct labels.
- 5. Stencils.
- 6. Valve tags.
- 7. Danger tags.
- 8. Warning tags.
- 9. Caution tags.
- 10. Ceiling grid

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

- 1. Material and Minimum Thickness, predrilled or stamped holes for attachment hardware: a. Brass. 0.032-inch.
- 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- 3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- 4. Fasteners: Stainless-steel;
 - a. Rivets or self-tapping screws
- 5. 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, and having predrilled holes for attachment hardware, 1/16 inch thick.
- 2. Letter Color:

8.

- a. Black.
- 3. Background Color:
 - a. 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-fourths the size of principal lettering.
- 7. Fasteners: Stainless-steel;
 - Rivets or self-tapping screws
 - 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), , plus the Specification Section number and title where equipment is specified. Label shall also include: capacity specified at designed operating conditions, actual capacity as balanced at site operating conditions, and area or zone served.
- 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), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 DANGER, WARNING AND CAUTION SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, having predrilled holes for attachment hardware; 1/16 inch thick.
- B. Danger signs, colors:
 - 1. Letter Color:

- a. White.
- 2. Background Color:
 - a. Red.
- C. Warning signs, colors:
 - Letter Color:
 - a. Black.
 - 2. Background Color:
 - a. Orange.
- D. Caution signs, colors:
 - Letter Color:
 - Black.
 - 2. Background Color:
 - a. Yellow.
- E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- H. Fasteners: Stainless-steel:
 - Rivets or self-tapping screws
- I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- J. 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.
- B. Pretensioned Pipe Labels: Precoiled, semirigid 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, 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 1-1/2 inches high.

2.4 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, having predrilled holes for attachment hardware; 1/16 inch thick.
- B. Letter Color:

- 1. As required per Duct Label Color Schedule
- C. Background Color:
 - As required per Duct Label Color Schedule
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel:
 - 1. 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, 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.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.5 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
 - 1. Stencil Material:
 - a. Aluminum.
 - 2. Stencil Paint:
 - a. Exterior, gloss, alkyd enamel black unless otherwise indicated.
 - b. Paint may be in pressurized spray-can form.
 - 3. Identification Paint:
 - Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated.

2.6 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material, predrilled or stamped holes for attachment hardware, minimum thickness:
 - a. Brass, 0.051-inch
 - b. At least 1 inch by 3 inch
 - 2. Fasteners: Steel;
 - a. Wire-link or beaded chain; or S-hook
 - 3. Label Content
 - a. Plan Identification
 - b. Normal Position
 - c. Duty

- d. Areas Served
- e. Valve Type

B. Valve Schedules:

- 1. For each piping system, on 8-1/2-by-11-inch bond paper, tabulate;
 - a. Valve number.
 - b. Piping system.
 - c. System abbreviation (as shown on valve tag).
 - d. Location of valve (room or space).
 - e. Normal-operating position (open, closed, or modulating).
 - f. Variations for identification.
 - g. Mark valves for emergency shutoff and similar special uses.
- 2. Valve-tag schedule:
 - a. Shall be included in operation and maintenance data.

2.7 VALVE TAGS FOR HEATING VALVES, STEAM VALVES, AND LOW PRESSURE SIDE HTW HEAT EXHANGERS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material, predrilled or stamped holes for attachment hardware, minimum thickness:
 - a. Brass, 0.051-inch
 - b. At least 1 inch by 3 inch
 - 2. Fasteners: Steel;
 - a. Wire-link or beaded chain; or S-hook
 - 3. Label Content
 - a. Plan Identification
 - b. Normal Position
 - c. Duty
 - d. Areas Served
 - e. Valve Type
 - f. Manufacturer
 - g. Size
 - h. Grade
 - i. Pressure-Temperature service rating

2.8 DANGER TAGS

- A. Danger Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size:
 - a. 3 by 5-1/4 inches minimum
 - 2. Fasteners:
 - Brass grommet and wire.
 - Nomenclature: Large-size primary caption such as "DANGER," and "DO NOT OPERATE."
 - 4. Color: Red background with white lettering.

2.9 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size:
 - a. 3 by 5-1/4 inches minimum
 - Fasteners:
 - a. Brass grommet and wire.
 - Nomenclature: Large-size primary caption such as "WARNING" and "DO NOT OPERATE."
 - 4. Color: Yellow background with black lettering.

2.10 CAUTION TAGS

- A. Caution Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size:
 - a. 3 by 5-1/4 inches minimum
 - 2. Fasteners:
 - Brass grommet and wire.
 - Nomenclature: Large-size primary caption such as "CAUTION," and "DO NOT OPERATE."
 - 4. Color: Orange background with black lettering.

2.11 CEILING GRID

- A. Provide red lettering on the ceiling tile grid of the locations of all fire dampers, smoke dampers and fire/smoke dampers. Size of lettering and verbiage is to conform to IBC and NFPA standards.
- B. Provide valve identification for all HVAC valves located above the ceiling on the ceiling grid below the valve.
- C. Provide VAV box identification for all VAV boxes located above the ceiling on the ceiling grid below the VAV box.

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 as specified in Division 09 Section "Exterior Painting" & "Interior Painting".
- B. Stenciled Pipe Label Option:
 - Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option.
 - Install stenciled pipe labels with painted, color-coded bands or rectangles on each piping system.
 - a. Identification Paint: Use for contrasting background.
 - b. Stencil Paint: Use for pipe marking.
- C. 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 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.
- D. Pipe Label Color Schedule:

MEDIUM IN PIPE	BACKGROUND	IDENTIFYING	LETTERING	
	COLOR	LETTERING	COLOR	
COMPRESSED GAS				
Hydrogen	Brown	Hydrogen	Black	
Natural Gas	Brown	Natural Gas	Yellow	
Oxygen	Brown	Oxygen	Black	
VACUUM				
Vacuum	Silver	Vacuum	Black	
WATER **NOTE: DIRECTIONAL ARROWS ARE REQUIRED ON HTW PIPING.				
Boiler Blow-Off	Yellow	Blow-Off Water	Black	
Chilled Water Sup-	Blue	Chilled Water Sup-	White	
ply		ply		
Chilled Water Re-	Blue	Chilled Water Re-	White	
turn		turn		
Condenser Water	Blue	Cooling Water	White	
Supply		Supply		
Condenser Water	Blue	Cooling Water Re-	Black	
Return		turn		
Condensate Return	Orange	Condensate Return	Black	
Cold Water (Pota-	Green	Domestic Cold Wa-	White	
ble)		ter		
Non Potable	Green	Unsafe Water	Black	
Domestic Hot Wa-	Green	Domestic Hot Wa-	White	
ter (Potable)		ter		
Domestic Hot Wa-	Green	Domestic Hot Wa-	White	
ter Return		ter Return		

Fire Protection Wa-	Red	Fire Protection	White	
ter				
Glycol Solution	Purple	Glycol Solution	White	
Secondary Heating	Brown	Heating Water	White	
Water Supply		Supply		
Secondary Heating	Brown	Heating Water Re-	White	
Water Return		turn		
Reverse Osmosis	Green	Rev. Osmosis Wa-	White	
		ter		
Softened	Green	Softened Water	Black	
Roof Drain	Green	Roof Drain	White	
System Make-Up	Green	Make-Up Water	White	
Treated Water	Green	Treated Water	Black	
WASTE				
Building Waste	(unpainted) or	Waste	White	
	Black			
ALL EQUIPMENT OR PIPING LOCATED OUTSIDE BUILDINGS				
All Equipment or	Brown			
Piping Located				
Outside Buildings				

3.4 DUCT LABEL INSTALLATION

- A. Install plastic-laminated 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.
 - 4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.
- 3.5 VALVE-TAG INSTALLATION (See Drawing Schedules.)
 - A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- 3.6 WARNING-TAG INSTALLATION
 - A. Write required message on, and attach warning tags to, equipment and other items where required.
- 3.7 ELECTRICAL SWITCHES AND STARTERS FOR MECHANICAL EQUIPMENT
 - A. Label all electrical switches and starters identifying equipment served.

END OF SECTION

SECTION 23 0593

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. Variable-air-volume systems.
 - 2. Balancing Hydronic Piping Systems:
 - a. Constant-flow hydronic systems.
 - b. Variable-flow hydronic systems.
 - c. Primary-secondary hydronic systems.
 - 3. Balancing Steam Systems.
 - 4. Various HVAC Equipment.
 - a. Heat Exchangers.
 - b. Motors.
 - c. Chillers.
 - d. Cooling Towers.
 - e. Condensing Units.
 - f. Boilers.
 - g. Heat Transfer Coils.
 - 5. Domestic Heater 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 ACTION SUBMITTALS

A. LEED Submittals:

- 1. Air-Balance Report for Prerequisite IEQ 1: Documentation of work performed for ASHRAE 62.1, Section 7.2.2 "Air Balancing."
- 2. TAB Report for Prerequisite EA 2: Documentation of work performed for ASHRAE/IESNA 90.1, Section 6.7.2.3 "System Balancing."

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within the following number of days of the 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;
 - 1. 30 days.
- B. Certified TAB reports.
- C. Instrument calibration reports, to include the following:
 - 1. Instrument type and make.
 - 2. Serial number.
 - Application.
 - 4. Dates of use.
 - Dates of calibration.

1.6 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC or NEBB.
 - TAB Field Supervisor: Employee of the TAB contractor and certified by AABC or NEBB and shall be the same as the TAB Contractor.
 - 2. TAB Technician: Employee of the TAB contractor and who is certified by AABC or NEBB as a TAB technician and shall be the same as the TAB Contractor.
- 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:
 - 1. Architect.
- 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."

1.7 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.

1.8 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 the following distribution systems have been satisfactorily completed:
 - Air and water.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TAB SPECIALISTS

- A. Subject to compliance with requirements, engage one of the following:
 - 1. BTC Service.
 - Certified Test & Balance.
 - 3. RS Analysis.

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:

- 1. Ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in:
 - a. Division 23 Section "Metal Ducts"
- 2. Verify ceiling plenums and underfloor air plenums used for supply, return or relief air are properly separated from adjacent areas.
- 3. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.

- 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. 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.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. 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. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke, and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.
 - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 8. 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 this section and:
 - 1. AABC's "National Standards for Total System Balance"
 - Comply with requirements in ASHRAE 62.1, Section 7.2.2 "Air Balancing."
- 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.
 - Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "Duct Insulation," Division 23 Section "HVAC Equipment Insulation," and Division 23 Section "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. Take and report testing and balancing measurements in inch-pound (IP) .

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 Division 23 Section "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.
 - Where sufficient space 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 one of the following entities for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for airhandling units for adjustment of fans, belts, and pulley sizes to achieve indicated airhandling-unit performance:
 - a. Architect.
 - 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.
 - 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. Remeasure 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.
 - 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 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.
 - 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. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - 7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
 - 8. Record final fan-performance data.
- C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
 - 1. Balance variable-air-volume systems the same as described for constant-volume air systems.
 - 2. Set terminal units and supply fan at full-airflow condition.

- Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
- 4. Readjust fan airflow for final maximum readings.
- 5. Measure operating static pressure at the sensor that controls the supply fan if one is installed, and verify operation of the static-pressure controller.
- 6. 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 the outlets balanced for maximum airflow.
- 7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
- D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
 - Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
 - 2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
 - 3. Set terminal units at full-airflow condition.
 - 4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 - 5. Adjust terminal units for minimum airflow.
 - 6. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

3.8 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 - 1. Open all manual valves for maximum flow.
 - 2. Check liquid level in expansion tank.
 - 3. Check makeup water-station pressure gage for adequate pressure for highest vent.
 - 4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
 - 5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
 - 6. Set system controls so automatic valves are wide open to heat exchangers.
 - 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.

8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.9 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
 - Verify impeller size by operating the pump with the discharge valve closed. Read
 pressure differential across the pump. Convert pressure to head and correct for
 differences in gage heights. Note the point on manufacturer's pump curve at zero flow
 and verify that the pump has the intended impeller size.
 - a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from the following entity and comply with requirements in Division 23 Section "Hvdronic Pumps.":
 - 1) Architect.
 - Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 - Monitor motor performance during procedures and do not operate motors in overload conditions.
 - 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 - 4. Report flow rates that are not within plus or minus 10 percent of design.
- B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
- C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
- D. Set calibrated balancing valves, if installed, at calculated presettings.
- E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 - 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
 - 1. Determine the balancing station with the highest percentage over indicated flow.
 - 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 - 3. Record settings and mark balancing devices.
- H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

- I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
- J. Check settings and operation of each safety valve. Record settings.

3.10 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.11 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

A. Balance the primary circuit flow first and then balance the secondary circuits.

3.12 PROCEDURES FOR STEAM SYSTEMS

- A. Measure and record upstream and downstream pressure of each piece of equipment.
- B. Measure and record upstream and downstream steam pressure of pressure-reducing valves.
- C. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.
- D. Check settings and operation of each safety valve. Record settings.
- E. Verify the operation of each steam trap.

3.13 PROCEDURES FOR HEAT EXCHANGERS

- A. Measure water flow through all circuits.
- B. Adjust water flow to within specified tolerances.
- C. Measure inlet and outlet water temperatures.
- D. Measure inlet steam pressure.
- E. Check settings and operation of safety and relief valves. Record settings.

3.14 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.
 - Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating.
 - 5. Motor balanced frequency and the date & time it was balanced.
 - 6. Drive kW.
 - Drive torque.
 - 8. Nameplate and measured voltage, each phase.
 - 9. Nameplate and measured amperage, each phase.
 - 10. 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.

3.15 PROCEDURES FOR CHILLERS

- A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
 - 1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
 - 2. For water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
 - 3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
 - 4. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
 - 5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
 - 6. Capacity: Calculate in tons of cooling.
 - 7. For air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.16 PROCEDURES FOR COOLING TOWERS

- A. Shut off makeup water for the duration of the test, and verify that makeup and blowdown systems are fully operational after tests and before leaving the equipment. Perform the following tests and record the results:
 - 1. Measure condenser-water flow to each cell of the cooling tower.
 - 2. Measure entering- and leaving-water temperatures.
 - 3. Measure wet- and dry-bulb temperatures of entering air.
 - 4. Measure wet- and dry-bulb temperatures of leaving air.
 - 5. Measure condenser-water flow rate recirculating through the cooling tower.
 - 6. Measure cooling-tower spray pump discharge pressure.
 - 7. Adjust water level and feed rate of makeup water system.
 - 8. Measure flow through bypass.

3.17 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.18 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each water coil:
 - 1. Entering- and leaving-water temperature.
 - 2. Water flow rate.
 - 3. Water pressure drop.

- Dry-bulb temperature of entering and leaving air.
- 5. Wet-bulb temperature of entering and leaving air for cooling coils.
- 6. Airflow.
- 7. Air pressure drop.
- B. Measure, adjust, and record the following data for each electric heating coil:
 - Nameplate data.
 - Airflow.
 - 3. Entering- and leaving-air temperature at full load.
 - 4. Voltage and amperage input of each phase at full load and at each incremental stage.
 - Calculated kilowatt at full load.
 - 6. Fuse or circuit-breaker rating for overload protection.
- C. Measure, adjust, and record the following data for each steam coil:
 - 1. Dry-bulb temperature of entering and leaving air.
 - Airflow.
 - 3. Air pressure drop.
 - 4. Inlet steam pressure.
- D. Measure, adjust, and record the following data for each refrigerant coil:
 - 1. Dry-bulb temperature of entering and leaving air.
 - 2. Wet-bulb temperature of entering and leaving air.
 - 3. Airflow.
 - 4. Air pressure drop.
 - 5. Refrigerant suction pressure and temperature.

3.19 DOMESTIC HEATER SYSTEMS

A. Test domestic heater system per Engineer's instructions.

3.20 AIRBORNE INFECTIOUS ISOLATION (AII) & PROTECTIVE ENVIRONMENT (PE) ROOMS

- A. After construction has been completed, but prior to occupancy in these rooms the TAB contractor is to measure, adjust, record, and report the following data for each AII or PE room:
 - 1. Supply airflow.
 - Return airflow.
 - 3. Exhaust airflow.
 - 4. Room pressure relative to adjacent spaces.
 - 5. Prove that the room will maintain either a positive or negative 0.03-inch WC pressure differential, depending on the room's pressure requirement as called for by the design engineer.
 - 6. Proper operation of room controls.
 - 7. Functionality of pressure monitors & alarms.

3.21 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 10 percent.
 - 2. Air Outlets and Inlets: Plus or minus 10 percent.
 - 3. Heating-Water Flow Rate: Plus or minus 10 percent.

4. Cooling-Water Flow Rate: Plus or minus 10 percent.

3.22 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare progress reports on the following interval to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors:
 - 1. Weekly.

3.23 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.
 - Fan curves.
 - 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. Architect's name and address.
 - 6. Engineer's name and address.
 - Contractor's name and address.
 - 8. Report date.
 - 9. Signature of TAB supervisor who certifies the report.
 - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 - 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 - 12. Nomenclature sheets for each item of equipment.

- 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
- 14. Notes to explain why certain final data in the body of reports vary from indicated values.
- 15. 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.
 - 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-Handling-Unit Test Reports: For air-handling units with coils, include the following:
 - 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches, and bore.
 - i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - j. Number, make, and size of belts.
 - k. Number, type, and size of filters.
 - 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - 3. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Filter static-pressure differential in inches wg.
 - f. Preheat-coil static-pressure differential in inches wg.

- g. Cooling-coil static-pressure differential in inches wg.
- h. Heating-coil static-pressure differential in inches wg.
- i. Outdoor airflow in cfm.
- j. Return airflow in cfm.
- k. Outdoor-air damper position.
- I. Return-air damper position.
- m. Vortex damper position.

F. Apparatus-Coil Test Reports:

- Coil Data:
 - a. System identification.
 - b. Location.
 - c. Coil type.
 - d. Number of rows.
 - e. Fin spacing in fins per inch o.c.
 - f. Make and model number.
 - g. Face area in sq. ft..
 - h. Tube size in NPS.
 - i. Tube and fin materials.
 - j. Circuiting arrangement.
- 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Average face velocity in fpm.
 - c. Air pressure drop in inches wg.
 - d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
 - e. Return-air, wet- and dry-bulb temperatures in deg F.
 - f. Entering-air, wet- and dry-bulb temperatures in deg F.
 - g. Leaving-air, wet- and dry-bulb temperatures in deg F.
 - h. Water flow rate in gpm.
 - i. Water pressure differential in feet of head or psig.
 - j. Entering-water temperature in deg F.
 - k. Leaving-water temperature in deg F.
 - I. Refrigerant expansion valve and refrigerant types.
 - m. Refrigerant suction pressure in psig.
 - n. Refrigerant suction temperature in deg F.
 - o. Inlet steam pressure in psig.
- G. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
 - 1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Fuel type in input data.
 - g. Output capacity in Btu/h.
 - h. Ignition type.
 - i. Burner-control types.
 - j. Motor horsepower and rpm.
 - k. Motor volts, phase, and hertz.
 - I. Motor full-load amperage and service factor.
 - m. Sheave make, size in inches, and bore.

- n. Center-to-center dimensions of sheave, and amount of adjustments in inches.
- 2. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm.
 - b. Entering-air temperature in deg F.
 - c. Leaving-air temperature in deg F.
 - d. Air temperature differential in deg F.
 - e. Entering-air static pressure in inches wg.
 - f. Leaving-air static pressure in inches wg.
 - g. Air static-pressure differential in inches wg.
 - h. Low-fire fuel input in Btu/h.
 - i. High-fire fuel input in Btu/h.
 - j. Manifold pressure in psig.
 - k. High-temperature-limit setting in deg F.
 - I. Operating set point in Btu/h.
 - m. Motor voltage at each connection.
 - n. Motor amperage for each phase.
 - o. Heating value of fuel in Btu/h.
- H. Fan Test Reports: For supply, return, and exhaust fans, include the following:
 - 1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - g. Number, make, and size of belts.
 - 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.
- I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
 - 1. Report Data:
 - a. System and air-handling-unit number.
 - b. Location and zone.

- c. Traverse air temperature in deg F.
- d. Duct static pressure in inches wg.
- e. Duct size in inches.
- f. Duct area in sq. ft..
- g. Indicated air flow rate in cfm.
- h. Indicated velocity in fpm.
- i. Actual air flow rate in cfm.
- j. Actual average velocity in fpm.
- k. Barometric pressure in psig.
- J. 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.
 - b. Air velocity in fpm.
 - c. Preliminary air flow rate as needed in cfm.
 - d. Preliminary velocity as needed in fpm.
 - e. Final air flow rate in cfm.
 - f. Final velocity in fpm.
 - g. Space temperature in deg F.
- K. 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.
 - b. Entering-water temperature in deg F.
 - c. Leaving-water temperature in deg F.
 - d. Water pressure drop in feet of head or psig.
 - e. Entering-air temperature in deg F.
 - f. Leaving-air temperature in deg F.
- L. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
 - 1. Unit Data:

- Unit identification.
- b. Location.
- c. Service.
- d. Make and size.
- e. Model number and serial number.
- f. Water flow rate in gpm.
- g. Water pressure differential in feet of head or psig.
- h. Required net positive suction head in feet of head or psig.
- i. Pump rpm.
- j. Impeller diameter in inches.
- k. Motor make and frame size.
- I. Motor horsepower and rpm.
- m. Voltage at each connection.
- n. Amperage for each phase.
- o. Full-load amperage and service factor.
- p. Seal type.

2. Test Data (Indicated and Actual Values):

- a. Static head in feet of head or psig.
- b. Pump shutoff pressure in feet of head or psig.
- c. Actual impeller size in inches.
- d. Full-open flow rate in gpm.
- e. Full-open pressure in feet of head or psig.
- f. Final discharge pressure in feet of head or psig.
- g. Final suction pressure in feet of head or psig.
- h. Final total pressure in feet of head or psig.
- i. Final water flow rate in gpm.
- j. Voltage at each connection.
- k. Amperage for each phase.

M. Instrument Calibration Reports:

1. Report Data:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

3.24 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 5 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:
 - a. Architect.
- 2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of:
 - a. Architect.
- 3. The following entity 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:
 - a. Architect.
- 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.

3.25 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- 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

SECTION 23 0713

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.
 - 3. Indoor, concealed return located in unconditioned space.
 - 4. Indoor, exposed return located in unconditioned space.
 - 5. Outdoor, concealed supply and return.
 - 6. Outdoor, exposed supply and return.

B. Related Sections:

- 1. Division 23 Section "HVAC Equipment Insulation."
- 2. Division 23 Section "HVAC Piping Insulation."
- 3. Division 23 Section "Metal Ducts" for duct liners.
- 4. Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

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).

B. LEED Submittals:

- 1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.
- 2. Laboratory Test Reports for Credit IEQ 4: For adhesives and 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."
- 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 insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
 - 3. Detail application of field-applied jackets.
 - 4. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

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 Division 23 Section "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," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC: AP Armaflex.
 - c. K-Flex USA; Insul-Sheet, K-Flex Gray Duct Liner, and K-FLEX LS.
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville: Microlite.
 - c. Knauf Insulation; Friendly Feel Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; SOFTR All-Service Duct Wrap.
- H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.: Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.
 - d. Knauf Insulation; Insulation Board.
 - e. Manson Insulation Inc.; AK Board.
 - f. Owens Corning; Fiberglas 700 Series.
- I. 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.
 - 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Armacell LLC; Tubolit.
- b. Nomaco Insulation; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.

2.2 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F. Comply with ASTM C 656, Type II, Grade 6. Tested and certified to provide a:
 - a. 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Johns Manville; Super Firetemp M.
- B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a:
 - a. 2-hour fire rating by an NRTL acceptable to authorities
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; FlameChek.
 - b. Johns Manville; Firetemp Wrap.
 - c. Nelson Fire Stop Products; Nelson FSB Flameshield Blanket.
 - d. Thermal Ceramics; FireMaster Duct Wrap.
 - e. 3M; Fire Barrier Wrap Products.
 - f. Unifrax Corporation; FyreWrap.

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. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA, Inc.: Aeroseal.
 - b. Armacell LLC; Armaflex 520 Adhesive.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
 - d. K-Flex USA; R-373 Contact Adhesive.
 - 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).
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 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-127.
 - b. Eagle Bridges Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.

- 2. 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).
- D. FSK Jacket Adhesive, and ASJ 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.
 - d. 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).

2.4 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. 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.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
 - 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-10.
 - b. Eagle Bridges Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
 - 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: 60 percent by volume and 66 percent by weight.
 - 5. Color: White.

2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
 - 1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. 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-50 AHV2.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
 - c. Vimasco Corporation; 713 and 714.
 - 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
 - 4. Service Temperature Range: 0 to plus 180 deg F.
 - 5. Color: White.

2.6 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
 - 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-76.
 - b. Eagle Bridges Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company: 95-44.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 3. Fire- and water-resistant, flexible, elastomeric sealant.
 - 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 5. Color: Aluminum.
 - 6. 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).

2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

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. Metal Jacket:

- 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; Metal Jacketing Systems.
 - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
 - c. RPR Products, Inc.; Insul-Mate.
- 2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft.

2.9 TAPES

- A. FSK Tape: Foil-face, 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; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
 - 2. Width: 3 inches.
 - 3. Thickness: 6.5 mils.
 - 4. Adhesion: 90 ounces force/inch in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strenath: 40 lbf/inch in width.
 - 7. FSK Tape Disks and Squares: Precut disks or squares of FSK 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.

2.10 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. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal.
- 3. 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:
 - 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 to 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 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, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.

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. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.

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

3.4 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.
 - Comply with requirements in Section 078413 "Penetration Firestopping" 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 manufacturers 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:
 - a. 100 percent coverage of duct and plenum surfaces.
 - 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 - 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:
 - On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.

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

- 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - Repair punctures, tears, and penetrations with tape or mastic to maintain vaporbarrier seal.
- 5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
- 6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.7 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 overlap at seams and joints.
 - 2. Embed glass cloth between two 0.062-inch- 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 laps at longitudinal seams and 3-inch- wide joint strips at end ioints.
 - 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 overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturers 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 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.

3.8 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 Division 07 Section "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 Division 09 Section "Exterior Painting" and "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. Testing Agency:
 - a. Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location (s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
- D. 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, concealed supply and outdoor air.
 - 2. Indoor, exposed supply and outdoor air.
 - 3. Indoor, concealed return located in unconditioned space.
 - 4. Indoor, exposed return located in unconditioned space.
 - 5. Outdoor, concealed supply and return.
 - 6. Outdoor, exposed supply and return.
- B. Items Not Insulated:
 - 1. Fibrous-glass ducts.
 - 2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
 - 3. Factory-insulated flexible ducts.

- 4. Factory-insulated plenums and casings.
- Flexible connectors.
- 6. Vibration-control devices.
- 7. Factory-insulated access panels and doors.
- Insulation shall have an R value that meets the minimum requirements of the latest International Energy Conservation Code (IECC).

3.13 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, round and flat-oval, supply-air duct insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Blanket: 1 inch thick and 0.75-lb/cu. ft. nominal density.
- B. Concealed, round and flat-oval, return-air duct insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Blanket: 1 inch thick and 0.75-lb/cu. ft. nominal density.
- C. Concealed, round and flat-oval, outdoor-air and combustion-air duct insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Blanket: 1 inch thick and 0.75-lb/cu. ft. nominal density.
- D. Concealed, round and flat-oval, exhaust-air duct insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Blanket: 1 inch thick and 0.75-lb/cu. ft. nominal density.
- E. Concealed, rectangular, supply-air duct insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Blanket: 1 inch thick and 0.75-lb/cu. ft. nominal density.
- F. Concealed, rectangular, return-air duct insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Blanket: 1 inch thick and 0.75-lb/cu. ft. nominal density.
- G. Concealed, rectangular, outdoor-air and combustion-air duct insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Blanket: 1 inch thick and 0.75-lb/cu. ft. nominal density.
- H. Concealed, supply-air plenum insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Blanket: 1 inch thick and 0.75-lb/cu. ft. nominal density.
- I. Concealed, return-air plenum insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Blanket: 1 inch thick and 0.75-lb/cu. ft. nominal density.

- J. Concealed, outdoor-air plenum insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Blanket: 1 inch thick and 0.75-lb/cu. ft. nominal density.
- K. Exposed, round and flat-oval, supply-air duct insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Blanket: 1 inch thick and 0.75-lb/cu. ft. nominal density.
- L. Exposed, round and flat-oval, return-air duct insulation shall be one of the following:
 - Flexible Elastomeric: 1 inch thick.
- M. Exposed, round and flat-oval, outdoor-air and combustion-air duct insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Blanket: 1 inch thick and 0.75-lb/cu. ft. nominal density.
- N. Exposed, rectangular, supply-air duct insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Blanket: 1 inch thick and 0.75-lb/cu. ft. nominal density.
- O. Exposed, rectangular, return-air duct insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Blanket: 1 inch thick and 0.75-lb/cu. ft. nominal density.
- P. Exposed, rectangular, outdoor-air and combustion-air duct insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Blanket: 1 inch thick and 0.75-lb/cu. ft. nominal density.
- Q. Exposed, supply-air plenum insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Blanket: 1 inch thick and 0.75-lb/cu. ft. nominal density.
- R. Exposed, return-air plenum insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1 inch thick.
 - 2. Mineral-Fiber Blanket: 1 inch thick and 0.75-lb/cu. ft. nominal density.

3.14 UNCONDITIONED SPACE AND BURIED DUCT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.
- B. Concealed, round and flat-oval, supply-air duct insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1.5 inches thick.
 - 2. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.
 - 3. Polyolefin: 1.5 inches thick.

- C. Concealed, round and flat-oval, return-air duct insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1.5 inches thick.
 - 2. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.
 - 3. Polyolefin: 1.5 inches thick.
- D. Concealed, round and flat-oval, outdoor-air and combustion-air duct insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1.5 inches thick.
 - 2. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.
 - 3. Polyolefin: 1.5 inches thick.
- E. Concealed, round and flat-oval, exhaust-air duct insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1.5 inches thick.
 - 2. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.
 - 3. Polyolefin: 1.5 inches thick.
- F. Concealed, rectangular, supply-air duct insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1.5 inches thick.
 - 2. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.
 - 3. Polyolefin: 1.5 inches thick.
- G. Concealed, rectangular, return-air duct insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1.5 inches thick.
 - 2. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.
 - 3. Polyolefin: 1.5 inches thick.
- H. Concealed, rectangular, outdoor-air and combustion-air duct insulation shall be one of the following:
 - 1. Flexible Elastomeric: 1.5 inches thick.
 - 2. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.
 - 3. Polyolefin: 1.5 inches thick.

3.15 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.
- B. Exposed, round and flat-oval, supply-air duct insulation shall be one of the following:
 - 1. Flexible Elastomeric: 3 inches thick.
 - 2. Polyolefin: 3 inches thick.
- C. Exposed, round and flat-oval, return-air duct insulation shall be one of the following:
 - 1. Flexible Elastomeric: 3 inches thick.
 - 2. Polyolefin: 3 inches thick.
- D. Exposed, rectangular, supply-air duct insulation shall be one of the following:
 - 1. Flexible Elastomeric: 3 inches thick.
 - 2. Polyolefin: 3 inches thick.

- E. Exposed, rectangular, return-air duct insulation shall be one of the following:
 - 1. Flexible Elastomeric: 3 inches thick.
 - 2. Polyolefin: 3 inches thick.
- F. Exposed, supply-air plenum insulation shall be one of the following:
 - 1. Flexible Elastomeric: 3 inches thick.
 - 2. Polyolefin: 3 inches thick.
- G. Exposed, return-air plenum insulation shall be one of the following:
 - 1. Flexible Elastomeric: 3 inches thick.
 - 2. Polyolefin: 3 inches thick.

3.16 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Ducts and Plenums, Concealed:
 - 1. Aluminum, Corrugated: 0.032 inch thick.
- D. Ducts and Plenums, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
 - 1. Aluminum, Corrugated: 0.032 inch thick.
- E. Ducts and Plenums, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
 - 1. Aluminum, with 1-1/4-Inch- Deep Corrugations: 0.032 inch thick.

END OF SECTION

SECTION 23 0719

HVAC PIPING 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 HVAC piping systems:
 - 1. Condensate drain piping.
 - 2. Chilled-water piping.
 - 3. Condenser-water piping.
 - 4. Heating hot-water piping.
 - 5. Steam and steam condensate piping.
 - 6. Refrigerant suction and hot-gas piping.

B. Related Sections:

- Division 23 Section "Duct Insulation."
- 2. Division 23 Section "HVAC Equipment Insulation."

1.3 DEFINITIONS:

A. Refer to Division 23 Section "Common Work Results for HVAC".

1.4 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).

B. LEED Submittals:

- 1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.
- Laboratory Test Reports for Credit IEQ 4: For adhesives and 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."
- 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.
- 6. Detail application of field-applied jackets.
- 7. Detail application at linkages of control devices.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

1.6 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 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.

1.7 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.

1.8 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.9 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 "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. Insulation for below-ambient service requires a vapor-barrier.
- C. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- D. 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.
- E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- G. Calcium Silicate:
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Industrial Insulation Group (IIG); Thermo-12 Gold.
 - 2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
 - 3. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
 - 4. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.
- H. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA. Inc.: Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
- I. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553.
 - 1. Type II and ASTM C 1290, Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite.

- c. Knauf Insulation; Friendly Feel Duct Wrap.
- d. Manson Insulation Inc.; Alley Wrap.
- e. Owens Corning; SOFTR All-Service Duct Wrap.
- J. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Micro-Lok.
 - b. Knauf Insulation; 1000-Degree Pipe Insulation.
 - c. Manson Insulation Inc.; Alley-K.
 - d. Owens Corning; Fiberglas Pipe Insulation.
 - e. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A:
 - 1) with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- K. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied:
 - 1. ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.
- L. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Ramco Insulation, Inc.; Super-Stik.
- B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

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. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.

- 1. Products: Subject to compliance with requirements, provide one of the following:
 - Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-97.
 - b. Eagle Bridges Marathon Industries; 290.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-27.
 - d. Mon-Eco Industries, Inc.; 22-30.
 - e. Vimasco Corporation; 760.
- 2. 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).
- 3. 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 Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA, Inc.; Aeroseal.
 - b. Armacell LLC; Armaflex 520 Adhesive.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
 - d. K-Flex USA; R-373 Contact Adhesive.
 - 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).
 - 3. 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. 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-127.
 - b. Eagle Bridges Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
 - d. Mon-Eco Industries, Inc.; 22-25.
 - 2. 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).
 - 3. 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. 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.

- d. 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).
- F. PVC Jacket Adhesive: Compatible with PVC jacket.
 - Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 739, Dow Silicone.
 - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Polyco VP Adhesive.
 - 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).
 - 3. 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. 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.
 - Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
 - 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; Encacel.
 - b. Eagle Bridges Marathon Industries; 570.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
 - 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
 - 3. Service Temperature Range: Minus 50 to plus 220 deg F.
 - 4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 - 5. Color: White.
- D. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

- 1. Products: Subject to compliance with requirements, provide one of the following:
 - Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
- 2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
- 3. Service Temperature Range: Minus 20 to plus 180 deg F.
- 4. Solids Content: 60 percent by volume and 66 percent by weight.
- 5. Color: White.

2.5 SEALANTS

- A. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 3. Fire- and water-resistant, flexible, elastomeric sealant.
 - 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 5. Color: White.
 - 6. 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).
 - 7. 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-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.7 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. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics. Inc.: FG Series.
 - c. Proto Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.

- 2. Adhesive: As recommended by jacket material manufacturer.
- 3. Color: PVC. white: 30 mils thick.
- 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

C. Metal Jacket:

- 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; Metal Jacketing Systems.
 - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
 - c. RPR Products, Inc.; Insul-Mate.
- 2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications:
 - 1) 1-mil- thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications:
 - 1) 3-mil- thick, heat-bonded polyethylene and kraft paper.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.8 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. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
 - 2. Width: 2 inches.
 - 3. Thickness: 6 mils.
 - 4. Adhesion: 64 ounces force/inch in width.
 - 5. Elongation: 500 percent.
 - 6. Tensile Strength: 18 lbf/inch in width.
- C. 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.

2.9 SECUREMENTS

A. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

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.
 - 3. 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.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

- 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 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
 - a. 2 inches o.c.
 - b. 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:
 - Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

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 ioint 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 Division 07 section "Penetration Firestopping."

3.5 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 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.

3.6 INSTALLATION OF CALCIUM SILICATE INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
 - 1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
 - 2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
 - 3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.
- 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 block insulation of same material and thickness as pipe insulation.
 - 4. Finish flange insulation same as pipe insulation.
- 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 insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
- 3. Finish fittings insulation same as pipe insulation.

D. Insulation Installation on Valves and Pipe Specialties:

- 1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
- 2. Install insulation to flanges as specified for flange insulation application.
- 3. Finish valve and specialty insulation same as pipe insulation.

3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturers 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 manufacturers 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:
 - 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.

3.8 INSTALLATION OF MINERAL-FIBER 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:

- 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.

3.9 FIELD-APPLIED JACKET INSTALLATION

- A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturers 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.

3.10 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.

3.11 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:

- 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric:
 - 1) 1/2 inch thick
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I:
 - 1) 1/2 inch thick
- B. Chilled Water, 40 Deg F and below:
 - 1. NPS 1-1/2 inch and Smaller: Insulation shall be the following:
 - a. Flexible Elastomeric:
 - 1) 1-1/2 inch thick.
 - 2. NPS 2 inch and Larger: Insulation shall be the following:
 - a. Flexible Elastomeric:
 - 1) 2 inch thick
 - 3. Insulation for runouts not exceeding 48 inches in length for connection to equipment shall be the following:
 - a. Flexible Elastomeric: 1 inch thick.
- C. Chilled Water, above 40 Deg F:
 - 1. NPS 1-1/2 inch and Smaller: Insulation shall be the following:
 - a. Flexible Elastomeric:
 - 1) 1-1/2 inch thick.
 - b. Mineral-Fiber, Preformed Pipe, Type I:
 - 1) 1-1/2 inches thick.
 - 2. NPS 2 inch and Larger: Insulation shall be the following:
 - a. Flexible Elastomeric:
 - 1) 2 inch thick.
 - b. Mineral-Fiber, Preformed Pipe, Type I:
 - 1) 2 inch thick.
 - 3. Insulation runouts not exceeding 48 inches in length for connection to equipment shall be one of the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Mineral-Fiber, Preformed Pipe, Type I: 1 inch thick
- D. Condenser-Water Supply and Return:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Mineral-Fiber, Preformed Pipe, Type I:
 - 1) 1 inch thick
 - 2. Condenser-water supply and return piping located indoors and operating in range of 55 to 105 deg F (13 to 41 deg C) is not always insulated. If condenser-water system operates as part of a water-side economizer cycle or if Project requires condensation control, piping should be insulated.
- E. Heating-Hot-Water Supply and Return, 200 Deg F and Below:
 - 1. NPS 1 1/2 and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I:
 - 1) 1-1/2 inch thick
 - 2. Greater than NPS 1-1/2 inch: Insulation shall be the following:

- a. Mineral-Fiber, Preformed Pipe, Type I or Pipe and Tank Insulation:
 - 1) 2 inches thick
- 3. Insulation for runouts not exceeding 48 inches in length for connection to equipment shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 1 inch thick.
- F. Heating-Hot-Water Supply and Return, above 200 Deg F:
 - 1. NPS 1 and Smaller: Insulation shall be one of the following:
 - a. Calcium Silicate:
 - 1) 2 inches thick
 - b. Mineral-Fiber, Preformed Pipe, Type I or II:
 - 1) 1-1/2 inches thick
 - 2. NPS 1-1/4 and Larger: Insulation shall be one of the following:
 - a. Calcium Silicate:
 - 1) 3 inches thick
 - b. Mineral-Fiber, Preformed Pipe, Type I or II:
 - 1) 2 inches thick
 - 3. Insulation runouts not exceeding 48 inches in length for connection to equipment shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inch thick.
- G. Steam and Steam Condensate, 0 to 15 PSI, 200 Deg F to 250 Deg F:
 - 1. NPS 1 and Smaller: Insulation shall be one of the following:
 - a. Calcium Silicate:
 - 1) 2 inches thick
 - b. Mineral-Fiber, Preformed Pipe, Type I or II:
 - 1) 1-1/2 inches thick
 - 2. NPS 1-1/4 and Larger: Insulation shall be one of the following:
 - a. Calcium Silicate:
 - 1) 3 inches
 - b. Mineral-Fiber, Preformed Pipe, Type I or II or Pipe and Tank Insulation:
 - 1) 2 inches thick
 - 3. Insulation for runouts not exceeding 48" in length for connection to equipment shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inch thick.
- H. Steam and Steam Condensate, 16 to 60 PSI, 251 Deg F to 305 Deg F:
 - 1. NPS 1 and Smaller: Insulation shall be one of the following:
 - a. Calcium Silicate: 3 inches thick.
 - b. Mineral-Fiber, Preformed Pipe, Type I or II: 2 inches thick.
 - 2. NPS 1-1/4 and Larger: Insulation shall be one of the following:

- a. Calcium Silicate: 3 inches thick.
- b. Mineral-Fiber, Preformed Pipe, Type I or II or Pipe and Tank Insulation: 2 inches thick.
- 3. Insulation for runouts not exceeding 48inches in length for connection to equipment shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inch thick.
- I. Refrigerant Suction and Hot-Gas Piping:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch thick.
- J. Refrigerant Suction and Hot-Gas Flexible Tubing:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 1 inch thick.

3.12 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. None.
- D. Piping, Exposed:
 - 1. PVC:
 - a. PVC, white: 30 mils thick.
- E. Steam Piping, Exposed:
 - 1. Aluminum, Stucco Embossed: 0.016 inch thick.

3.13 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
 - 1. None.
- D. Piping, Exposed:
 - 1. Aluminum, Stucco Embossed: 0.016 inch thick.

3.14 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION

SECTION 23 0900

INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The Facility Management and Control System (FMCS) Contractor shall furnish and install a fully integrated building automation system, incorporating direct digital control (DDC) for energy management, equipment monitoring and control as herein specified. The system shall include all required computer software and hardware, controllers, sensors, transmission equipment, system workstations, local panels, conduit, wire, installation, engineering, database and setup, supervision, commissioning, acceptance test, training, warranty service and, at the owner's option, extended warranty service.
- B. The system shall use BacNet as its floor level protocol. System components shall be certified and display the BTL logo where applicable.
- C. The FMCS shall be capable of total integration of the facility infrastructure systems with user access to all system data either locally over a secure Intranet within the building or by remote access by a standard Web Browser over the Internet.
- D. The FMCS shall demonstrate, with (3) proof sources, integration with HVAC industry open standard protocols, including LonMark, BacNet, ModBus and Internet standard SQL database and HTTP / HTML / XML text formats.
- E. The FMCS shall communicate to third party systems such as air handling systems and other building management related devices using any of the open, interoperable communication protocols referenced in Paragraph D.
- F. All materials and equipment used shall be standard components, regularly manufactured for this and/or other systems and not custom designed especially for this project.
- G. Plenum rated cable is allow for all control voltage.
- H. Work shall include a continuation of the usage of the existing JCI system.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

- A. Drawings and general provisions of the Contract, including General and supplementary Conditions and Division-1 specification sections, apply to work of this section.
- B. Products furnished but not installed under this section:
 - 1. Valves, flow switches, flow sensors, thermowells and pressure taps to be installed under section 23.
 - 2. Automatic dampers to be installed under Division 23.
- C. Coordination with electrical:
 - 1. Installation of all line voltage power wiring by division 26.

2. Each motor starter provided under Division 26, shall be furnished with individual control power transformer to supply 120 volt control power and auxiliary contacts (one N.O. and one N.C.) for use by this section.

1.3 QUALITY ASSURANCE

- A. The system shall be furnished, engineered, and installed by the manufacturers' locally authorized representative. The controls contractor shall have factory-trained technicians to provide instruction, routine maintenance, and emergency service within 24 hours upon receipt of request.
- B. At the time of bid, all BCS Application Specific Controllers and Programmable Equipment Controllers shall be listed as follows:
 - 1. Underwriters Laboratory UL 916
 - 2. FCC Regulation, Part 15, Class B

1.4 SUBMITTALS

- A. Submit 10 complete sets of documentation in the following phased delivery schedule:
 - 1. Valve and damper schedules
 - 2. Equipment data cut sheets
 - 3. System schematics, including:
 - a. point to point wiring
 - b. interface wiring diagrams
 - c. panel layouts
 - d. system riser diagrams
 - e. sequence of operations

4. Software:

- a. graphics
- b. point names
- c. point addresses
- d. point to point wiring check off lists
- 5. AutoCAD® compatible as-built drawings
- B. Upon project completion, submit operation and maintenance manuals, consisting of the following:
 - 1. Index sheet, listing contents in alphabetical order
 - 2. Manufacturer's equipment parts list of all functional components of the system, disk of system schematics, including wiring diagrams
 - 3. Description of sequence of operations
 - 4. As-Built interconnection wiring diagrams
 - 5. User's documentation containing product, system architectural and programming information.
 - 6. Trunk cable schematic showing remote electronic panel locations, and all trunk data
 - 7. List of connected data points, including panels to which they are connected and input device (ionization detector, sensors, etc.)
 - 8. Conduit routing diagrams

- 9. Copy of the warranty/guarantee
- 10. Operating and maintenance cautions and instructions
- 11. Recommended spare parts list

1.5 COMMISSIONING COORDINATION

A. Contractors shall include time as necessary to assist the commissioning agent in commissioning the project. Refer to Section 019113 General Commissioning Requirements, 230800 Commissioning of HVAC and Measurement and Verification Plan.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Johnson Controls Tridium System
- 2.2 The Facility Management Control System (FMCS) shall be comprised of a network of interoperable, stand-alone digital controllers. The FMCS shall incorporate BacNet technology. The system shall include:
 - A. Programmable Equipment Controllers (PEC's) for control of primary mechanical systems and distributed system applications. Controllers shall be fully programmable to create custom control solutions.
 - B. Network Area Controllers (NAC's) for distributed system applications, databases and networking functions.
 - C. Application Specific Controllers (ASC's) for control of VAV terminal units, Fan coil terminal units, Unit Vent terminal units, Heat Pump units and other terminal equipment.
 - D. Graphical User Interface (GUI), which includes the hardware and software necessary for a user to interface with the control system and devices.
- 2.3 The controller network shall use polarity insensitive twisted pair wiring and support star, home run, multi-drop, loop, or a mixture of these wiring topologies. The PEC and ASC network shall communicate at a minimum 78Kbps. The GUI and NAC shall reside on a 100 Mb Ethernet backbone.
- 2.4 All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.
- 2.5 Communication and integration of 3rd party BacNet products shall be accomplished without gateways or interface devices. The 3rd party product supplier shall provide BacNet pic statements for each device.

2.6 NETWORK AREA CONTROLLER (NAC)

A. The Network Area Controller (NAC) shall provide the interface between the field control devices, and provide global supervisory control functions over the control devices connected to the NAC. It shall be capable of executing application control programs to provide:

- 1. Calendar functions
- 2. Scheduling3. Trending
- 4. Alarm monitoring and routing
- 5. Time synchronization
- 6. Integration of BacNet controller data
- 7. Integration of BacNet and MODBUS networks
- 8. Network Management functions for all BacNet based devices
- 9. Employ Niagra AX operating system
- B. The NAC shall provide multiple, concurrent user access to the system and support for ODBC or SQL. A database resident on the NAC shall be an ODBC-compliant database or must provide an ODBC data access mechanism to read and write data stored within it.
- C. The NAC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.
- D. The NAC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
 - 1. The NAC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up, telephone connection, or wide-area
 - 2. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including, but not limited to:
 - a. To alarm
 - b. Return to normal
 - c. To fault
 - 3. Provide for the creation of an unlimited number of alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc.
 - 4. Provide timed (schedule) routing of alarms by class, object, group, or node.
 - 5. Provide alarm generation from binary object "runtime" and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.
- E. Alarms shall be annunciated in any of the following manners as user defined:
 - 1. Screen message text
 - 2. Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:
 - a. Day of week
 - b. Time of day
 - c. Recipient
 - 3. Pagers via paging services that initiate a page on receipt of email message
 - 4. Graphic with flashing alarm object(s)
 - 5. Printed message, routed directly to a dedicated alarm printer
- F. The following shall be recorded by the NAC for each alarm (at a minimum):
 - 1. Time and date
 - 2. Location (building, floor, zone, office number, etc.)

- 3. Equipment (air handler #, accessway, etc.)
- 4. Acknowledge time, date, and user who issued acknowledgement.
- 5. Number of occurrences since last acknowledgement.
- G. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.
- H. A log of all alarms shall be maintained by the NAC and/or a server (if configured in the system) and shall be available for review by the user.
- I. Provide a "query" feature to allow review of specific alarms by user defined parameters.
- J. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.
- K. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.
- L. Data Collection and Storage
 - 1. The NAC shall have the ability to collect data for any property of any object and store this data for future use.
 - 2. The data collection shall be performed by log objects, resident in the NAC that shall have, at a minimum, the following configurable properties:
 - a. Designating the log as interval or deviation.
 - b. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
 - c. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
 - d. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a firstin, first-out basis.
 - e. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.
 - 3. All log data shall be stored in a relational database in the NAC and the data shall be accessed from a server (if the system is so configured) or a standard Web Browser.
 - All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.
 - 5. All log data shall be available to the user in the following data formats:
 - a. HTML
 - b. XML
 - c. Plain Text
 - d. Comma or tab separated values
 - 6. Systems that do not provide log data in HTML and XML formats at a minimum shall not be acceptable.
 - 7. The NAC shall have the ability to archive its log data either locally (to itself), or remotely to a server or other NAC on the network. Provide the ability to configure the following archiving properties, at a minimum:
 - a. Archive on time of day
 - b. Archive on user-defined number of data stores in the buffer (size)

- c. Archive when buffer has reached its user-defined capacity
- M. Provide and maintain an Audit Log that tracks all activities performed on the NAC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the NAC), to another NAC on the network, or to a server. For each log entry, provide the following data:
 - 1. Time and date
 - 2. User ID
 - 3. Change or activity: i.e., Change set point, add or delete objects, commands, etc.
- N. The NAC shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.
 - Copies of the current database and, at the most recently saved database shall be stored in the NAC. The age of the most recently saved database is dependent on the userdefined database save interval.
 - 2. The NAC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.
- O. Each Network Area Controller (NAC) that is part of the Ethernet backbone shall include local battery backed UPSs sized for 30 minutes backup.

2.7 PROGRAMMABLE EQUIPMENT CONTROLLERS (PEC)

- A. Programmable Equipment Controllers (PEC's) shall be stand-alone, multi-tasking, real-time digital control processors.
- B. The PEC's shall communicate via native BacNet MSTP protocol. Provide a minimum of 4MB Random Access Memory in each PEC.
- C. The PEC must communicate peer-to-peer with the all of the network application specific, programmable controllers and third party BacNet devices.
- D. Programming of the PEC shall be accomplished by using graphical software that incorporates drag and drop capabilities. The PEC software database must be able to execute all of the specified mechanical system controls functions. The programming software shall be able to bundle software logic to simplify control sequencing. All values, which make up the PID output value, shall be readable and modifiable at a workstation or portable service tool. Each input, output, or calculation result shall be capable of being shared/bound with any controller or interface device on the network.
- E. PEC's shall be able to execute custom, job specific processes defined by the user, to automatically perform calculations and special control routines.
- F. A single process shall be able to incorporate measured or calculated data from any and all other PEC's on the network. In addition, a single process shall be able to issue commands to points in any and all other PEC's on the network.
- G. Each PEC shall support firmware upgrades without the need to replace hardware.

- H. Each PEC shall continuously perform self-diagnostics, which include communication diagnosis and diagnosis of all components. The PEC shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication.
- I. In the event of the loss of normal power, there shall be an orderly shutdown of all PEC's to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.
 - 1. Upon restoration of normal power, the PEC shall automatically resume full operation without manual intervention.
 - 2. All PEC's control programming and databases must be stored in Flash memory, therefore eliminating data loss, down time and re-load time.

2.8 APPLICATION SPECIFIC CONTROLLERS (ASC)

- A. Each Application Specific Controller (ASC) shall operate as a stand-alone BacNet compliant controller capable of performing its specified control responsibilities independent of other controllers in the network. Each ASC shall be a minimum 16-BIT microprocessor based, multi-tasking, multi-user, real time digital control processor.
- B. Service pin initiation shall be accomplished from the room sensor and/or the controller. ASC room sensors that do not provide service pin initiation must provide a wall jack by the room sensor to enable this feature.
- C. Controllers shall include all inputs and outputs necessary to perform the specified control sequences. Analog and digital outputs shall be industry standard signals such as 0-10V and 3-point floating control allowing for interface to a variety of industry standard modulating actuators. The ASC inputs and outputs shall consist of industry standards types. Inputs shall be electrically isolated from outputs, communications and power. All inputs shall be provided with an auto-calibrate function to eliminate sensing errors.
- D. All controller sequences and operation shall provide closed loop control of the intended application. Closing control loops over the network is not acceptable.
- E. The control program shall reside in the ASC. The application program and the configuration information shall be stored in non-volatile memory with no battery back-up required.
- F. After a power failure the ASC must run the control application using the current set points and configuration. Reverting to default or factory set points are not acceptable.

2.9 GRAPHICAL USER INTERFACE SOFTWARE (GUI)

- A. Operator workstations must be capable of supporting any BacNet compliant product. The operator shall not be able to distinguish the DDC points from different manufacturers when commanding, monitoring points or acknowledging alarms.
- B. The software shall provide a multi-tasking type environment that allows the user to run several applications simultaneously. The GUI software shall run on a Windows Vista or Windows 7 operating system. The operator shall be able to work in Microsoft Word, Excel, and other Windows based software packages, while concurrently annunciating on-line BMS alarms and monitoring information. If the software is unable to display several different types

- of displays at the same time, the BMS contractor shall provide at least two operator workstations at each location specified.
- C. Real-Time Displays. The GUI, shall at a minimum, support the following graphical features and functions:
 - Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of a graphic background, the GUI shall support the use of scanned pictures.
 - 2. A gallery of HVAC and automation symbols shall be provided, including fans, valves, motors, chillers, AHU systems, standard ductwork diagrams and symbols. The user shall have the ability to add custom symbols to the gallery as required.
 - 3. Graphic screens shall have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.
 - 4. Graphics shall support layering and each graphic object shall be configurable for assignment to a layer. A minimum of six layers shall be supported.
 - 5. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.
 - a. Schedule times will be adjusted by mouse command using a graphical slider, without requiring any keyboard entry from the operator.
 - b. Holidays shall be set by mouse command using a graphical calendar, without requiring any keyboard entry from the operator.
 - 6. Commands to start and stop binary objects shall be done by mouse command from the pop-up menu. No entry of text shall be required.
 - 7. Adjustments to analog objects, such as set points, shall be done by mouse command using a graphical slider to adjust the value. No entry of text shall be required.
- D. System Configuration. At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:
 - 1. Create, delete or modify control strategies.
 - 2. Add/delete objects to the system.
 - 3. Tune control loops through the adjustment of control loop parameters.
 - 4. Enable or disable control strategies.
 - 5. Generate hard copy records or control strategies on a printer.
 - 6. Select points to be alarmable and define the alarm state.
 - 7. Select points to be trended over a period of time and initiate the recording of values automatically.
- E. On-Line Help. Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.
- F. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is

- detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.
- G. System Diagnostics. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.
- H. The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console can be enabled or disabled by the system administrator.
- I. When the Alarm Console is enabled, a separate alarm notification window will supersede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable.

2.10 WEB BROWSER CLIENTS

- A. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer® or Netscape Navigator®. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, or manufacture-specific browsers shall not be acceptable.
- B. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Web page access and control shall be from system Network Area Controllers, or the Workstation.
- C. The Web browser shall provide the same system view, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.
- D. The Web browser client shall support at a minimum, the following functions:
 - 1. User log-on identification and password security shall be required and implemented using Java authentication and encryption techniques to prevent unauthorized access. If an unauthorized user attempts access, a blank web page shall be displayed.
 - 2. Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.
 - 3. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
 - 4. Storage of the graphical screens shall be in the Network Area Controller (NAC), without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client machine are not acceptable.
 - 5. Real-time values displayed on a Web page shall update automatically without requiring a manual "refresh" of the Web page.
 - 6. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:

- a. Modify in a graphical manner, common application objects, such as schedules, calendars, and set points. Schedule times will be adjusted by mouse command using a graphical slider, without requiring any keyboard entry from the operator. Holidays shall be set by mouse command using a graphical calendar, without requiring any keyboard entry from the operator.
- b. Commands to start and stop binary objects shall be done by mouse command rightclick of the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
- c. View logs and charts
- d. View and acknowledge alarms
- 7. The system shall provide the capability to specify a user's home page (as determined by the log-on user identification). The system shall provide the ability to limit a specific user to just their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.
- 8. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.
- E. Trend logging and system monitoring requirements.
 - 1. Trend data shall be stored for three years and be accessible through web-browser-based reporting tools.
 - 2. See Section 230800 for additional trending implementation requirements.

2.11 BACNET NETWORK MANAGEMENT

- A. Network management shall include the following services: device identification, device installation, device configuration, device diagnostics and device maintenance.
- B. The network management tool shall also provide diagnostics to identify devices on the network, to reset devices, and to view health and status counters within devices.
- C. These tools shall provide the ability to "learn" an existing BacNet network, regardless of what network management tool(s) were used to install the existing network, so that existing devices and newly added devices are part of a single network management database.
- D. The network management database shall be resident in the Network Area Controller (NAC), ensuring that users with proper authorization have access to the network management database at all times. Systems employing network management databases that are not resident at all times within the control system shall not be accepted.

2.12 PROJECT SPECIFIC WEB PAGES:

- A. The home page shall show a graphic of the building. The following minimum web-based tree structure shall be provided:
 - 1. Documents Page: The document page shall include the O&M Manuals for the control system in PDF format along with AutoCAD drawings for each drawing provided in the control system O&M Manual.
 - Station Functions:

- a. Logging separate sheet of station functions for a particular selected building shall be the viewing of one or more logs or the creation of logs in which any value at any point, or the mode of any point, shall be selected via the web to be trended against any other point with an adjustable frequency in seconds, minutes, hours or days.
- b. The alarm acknowledgement via the web shall allow the viewing and acknowledgement of the alarms.
- c. Audit log shall be provided via the web to show the operator actions as well as other audit logs as specified in section 2.5 Network Area Controller (NAC) paragraph "M" Data Collection and Storage.

Floor Plans:

- a. AutoCAD drawings of floor plans shall be provided in the control system such that via the web the user shall be able to turn layers on and off on the mechanical floor plans. These floor plans shall also include an overlay of the temperature control as-built wiring for the project showing thermostat locations, communication runs, transformer locations, controller locations, etc.
- b. Floor Display Summaries. The operator shall be able to select floor plans displaying the following formats:
 - 1. All zone temperatures
 - 2. All zone heating percentages
 - 3. All zone cooling percentages
 - 4. All zone room names and numbers
 - 5. All zones CFM delivered
- c. Upon selecting a graphical floor plan layout the web page shall show all the zone temperature sensor locations on the floor. By clicking on the zone temperature location, an individual VAV box graphic shall be displayed with the following attributes:
 - 1. A manual menu that shall allow the operator to manually set the air flow set point, space temperature set point, damper position, cooling percentage, heating percentage, and zero the box.
 - 2. A 24 hour log chart that shows space temperature history, flow history, and allows the operator to build custom charts by comparing this log to other associated selectable logs.
 - 3. A display of the VAV box discharge temperature damper position, air handler discharge temperature, space temperature, space temperature set point, and occupancy status.
 - 4. A bar graph that shows actual CFM, current air flow, and current air flow set point, percentage of heating and cooling in a thermometer-like fashion and changes color based on heating or cooling mode.
 - 5. The damper position, reheat valve position, occupancy status, room name and heating/cooling mode shall also be shown.

4. Systems:

a. On selecting the systems menu, a tree structure shall allow the operator to select the air handlers, boilers, chillers, control valves, pumps, heat exchangers, lab air flow valves and hoods, etc. systems associated with that building. The graphics shall also show the piping and ductwork associated with the air handler as well as the safeties, temperature sensors, humidity sensors, dampers, VFD's, associated with that fan system. See points lists for specifics.

- b. All devices that provide dynamic function in the primary equipment, i.e., fans, pumps, coils, dampers shall be dynamic in nature showing their operating status/percentage of capacity by movement on the web page.
- c. The set points for the various control loops shall be adjustable via the web page. Individual controlled devices, i.e., valves, dampers and fans shall be controlled via the web page and be stopped or started or placed in a command state or percentage of value output.

2.13 BUILDING OPERATORS/MANAGERS WORK STATION

- a. Siemens as part of their bid shall utilize the existing work station and upgrade the software as necessary to accommodate the remodel of all three phases of the project.
- b. Johnson Controls shall utilize the controls interface already installed in the Eccles Ambulatory Care Building. Both buildings will be required to have separate interfaces.

2.14 SENSORS & SWITCHES

A. TEMPERATURE SENSORS

- 1. Temperature Sensors: Temperature sensors shall be linear precision elements with ranges appropriate for each specific application. Where sensors are located in public areas they shall not employ set point adjustments or override capability. Set point adjustment shall be programmed for 2.5° maximum initially.
- 2. Space (room) sensors shall be available with set point adjustment and override switch.
- 3. Duct mounted averaging sensors shall utilize a sensing element incorporated in a copper capillary with a minimum length of 20 feet. The sensor shall be installed according to manufacture recommendation and looped and fastened at a minimum of every 36 inches. Averaging sensors shall be employed in mixed air, pre-heat coil, pre-cool coil, evap media and chilled water coil discharge temperature locations.
- 4. Sunshields shall be provided for outside air sensors.
- 5. Thermo-wells for all immersion sensors shall be stainless steel or brass as required for the application.
- B. Humidity Sensors: Humidity sensors shall be of the solid-state type using a capacitance-sensing element. The sensor shall vary the output voltage with a change in relative humidity. Room humidity sensors shall have a minimum range of 10% to 90% \pm 5%. Supply air humidity sensors shall have a normal range of 10% to 90% \pm 5%.
- C. Air Velocity Sensors: The sensor shall use differential pressure to determine airflow rate and have repeatability within 1% of reading and an accuracy of \pm 5% of range. The velocity range shall be from 0 to 3250 FPM.
- D. Pressure Sensors: The differential pressure sensor shall be temperature compensated and shall vary the output voltage with a change in differential pressure. Sensing range shall be suitable for the application with linearity of 1.5% of full scale and offset of less than 1% of full scale. Sensor shall be capable of withstanding up to 150% of rated pressure without damage. Sensor range shall not exceed 4 times the set point.
- E. Operating Room Combined Humidistat and Thermostat: The operating rooms shall be provided with a combination thermostat/humidistat. These stats shall have a digital display for both temperature and humidity. These stats shall report back to the building management system.

F. SWITCHES AND THERMOSTATS

- The FMCS Contractor shall furnish all electric relays and coordinate with the supplier of
 magnetic starters for auxiliary contact requirements. All electric control devices shall be
 of a type to meet current, voltage, and switching requirement of their particular
 application. Relays shall be provided with 24 VAC coils and contacts shall be rated at 10
 amps minimum.
- Duct Smoke Detectors: Duct smoke detectors shall be supplied by others with an integral auxiliary contact to be used by the FMCS contractor to provide a digital input to the FMCS
- 3. Low Temperature Detection Thermostats: Shall be the manual reset type. The thermostat shall operate in response to the coldest one-foot length of the 20-foot sensing element, regardless of the temperatures at other parts of the element. The element shall be properly supported to cover the entire downstream side of the coil with a minimum of three loops. Separate thermostats shall be provided for each 25 square feet of coil face area or fraction thereof.
- 4. Differential Pressure Switches: Pressure differential switches shall have SPDT changeover contact, switching at an adjustable differential pressure set point.
- 5. Current Sensing Relays: Motor status indications, where shown on the plans point list shall be provided via current sensing relays. The switch output contact shall be rated for 30 VDC, .15 amps.
- 6. Flow Switches: Motor status indications, where shown on the plans point list, shall be provided via flow switches. Flow switches shall be of the paddle type equipped with SPDT contacts to establish proof of flow.

G. CONTROL VALVES

- 1. General: Control Valves up to 4 inches shall be sized for a 2 psi maximum cooling system and 4 psi maximum heating system pressure drop. Valves shall be modulating, electrically or magnetically actuated, with a control rangeability of 50 to 1. These valves shall have an equal percentage flow characteristics in relationship to valve opening. Control valve to be of characterized ball valve type.
- 2. 4 inches to 6 inches: Valves shall be modulating electrically actuated, 2-way or 3-way as required, with a rangeability of 50 to 1. Valve body shall be flanged and shall be equipped with a handwheel, or manual position dial mounted adjacent to the valve, to allow manual positioning of the valve in the absence of control power. Control valve to be of characterized ball valve type.
- 3. Butterfly Valves: 2-way and 3-way butterfly valves shall be cast iron valve body, with stainless steel stem, and available with disc seal for bubble-tight shut off.

H. DAMPER ACTUATORS

1. Actuators shall be of the push-pull or rotary type of modulating, 3-point floating, or 2-position control as required by the application. The actuator shall use an overload-proof synchronous motor or an electric motor with end switches to de-energize the motor at the end of the stroke limits. Control signal shall be 24 VAC, 0-10 VDC, or 4-20 ma as required. Actuators shall be available with spring return to the normal position when required. Actuators shall have a position indicator for external indication of damper position. Actuators shall have manual override capability without disconnecting damper linkage.

I. CONTROL DAMPERS

1. Motorized dampers, unless otherwise specified elsewhere, shall have damper frames using 13 gauge galvanized steel channel or 1/8" extruded aluminum with reinforced corner bracing. Damper blades shall not exceed ten (10) inches in width or 48" in length. Blades are to be suitable for high velocity performance. Damper bearings shall be as

recommended by manufacturer for application. Bushings that turn in the bearing are to be oil impregnated sintered metal. All blade edges and top and bottom of the frame shall be provided with replaceable, butyl rubber or neoprene seals. Side seals may be spring-loaded stainless steel. The seals shall provide a maximum of 1% leakage at a wide open face velocity of 1500 FPM and 4: W.C. close-off pressure. The damper linkage shall provide a linear flow or equal percentage characteristic as required. Provide Ruskin RCD 36 model dampers.

2. Control dampers shall be parallel or opposed blade type as scheduled on drawings or outdoor and return air mixing box dampers shall be parallel blade, arranged to direct air streams towards each other. All other dampers may be parallel or opposed blade types.

PART 3 - EXECUTION

3.1 INSTALLATION METHODS FOR CONTROL SYSTEM

- A. Install systems and materials in accordance with manufacturer's instructions, rough-in drawings and equipment details. Install electrical components and use electrical products complying with requirements of applicable Division 16 sections of these specifications.
- B. The term "control wiring" is defined to include providing of wire, conduit, and miscellaneous materials as required for mounting and connecting electric or electronic control devices.
- C. All controllers, relays, transducers, etc., required for stand-alone control shall be housed in a NEMA 1 enclosure with a lockable door.

3.2 SYSTEM ACCEPTANCE

- A. General: The system installation shall be complete and tested for proper operation prior to acceptance testing for the Owner's authorized representative. A letter shall be submitted to the Architect requesting system acceptance. This letter shall certify all controls are installed and the software programs have been completely exercised for proper equipment operation. Acceptance testing will commence at a mutually agreeable time within ten (10) calendar days of request. When the field test procedures have been demonstrated to the Owner's representative, the system will be accepted. The warranty period will start at this time.
 - The contractor is required to deliver a functionally complete operating building. Provide unconditional one-year parts and service warranty. Warranty period commences when architectural substantial completion has been achieved and all the BMS controls commissioning issues have be resolved. At that time, a completion certificate will be issued by the Cx agent.
- B. Field Equipment Test Procedures: DDC control panels shall be demonstrated via a functional end-to-end test. Such that:
 - All output channels shall be commanded (on/off, stop/start, adjust, etc.) and their operation verified.
 - 2. All analog input channels shall be verified for proper operation.
 - 3. All digital input channels shall be verified by changing the state of the field device and observing the appropriate change of displayed value.
 - 4. If a point should fail testing, perform necessary repair action and retest failed point and all interlocked points.
 - 5. Automatic control operation shall be verified by introducing an error into the system and observing the proper corrective system response.

- 6. Selected time and set point schedules shall be verified by changing the schedule and observing the correct response on the controlled outputs.
- C. See Section 230800 for commissioning testing requirements for the BAS contractor to complete as part of this section 230900.
- D. As-Built Documentation: After a successful acceptance demonstration, the Contractor shall submit as-built drawings of the completed project for final approval. After receiving final approval, supply six complete 11x17 as-built drawing sets, together with AutoCAD diskettes to the owner.
- E. Operation and Maintenance Manuals: Submit four copies of operation and maintenance manuals. Operation and maintenance manuals shall also be on a fully searchable CD in PDF format. Include the following:
 - 1. Manufacturer's catalog data and specifications on sensors, transmitters, controllers, control valves, damper actuators, gauges, indicators, terminals and any miscellaneous components used in the system.
 - 2. A copy of the warranty.
 - 3. Operating and maintenance cautions and instructions.

3.3 TRAINING

- A. Contractor shall provide to the engineer a training class outline prior to any scheduled training.
- B. Factory trained control engineers and technicians shall provide training sessions for the Owner's personnel.
- C. The control contractor shall conduct three sessions of training which shall be up to four hours each for the designated owner's personnel in the maintenance and operation of the control system. Two four hour classes shall be given upon system acceptance and the other class quarterly as to accommodate owners need.
- D. The course shall include instruction on specific systems and instructions for operating the installed system to include as a minimum:
 - 1. HVAC system overview
 - 2. Operation of control system
 - 3. Function of each component
 - 4. System operating procedures
 - 5. Programming procedures
 - 6. Maintenance procedures

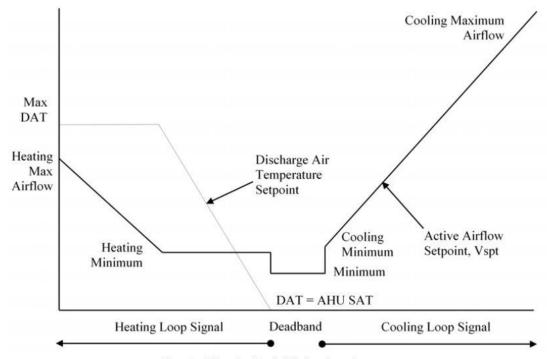
3.4 WARRANTY

A. The control system shall be warranted to be free from defects in both material and workmanship for a period of one (1) year of normal use and service. This warranty shall become effective the date the owner accepts or receives beneficial use of the system as defined by Utah state law.

PART 4 - SEQUENCE OF OPERATION

4.1 VAV ZONES WITH REHEAT COIL

- A. Occupied mode: During this mode the supply fans at the air handler will be enabled upon a call for heat. When the zone temperature is between the occupied heating and cooling setpoints, the primary air damper will be at the minimum and there will be no mechanical heating. On a rise in zone temperature above the cooling setpoint, the primary air damper will increase the CFM and there will be no mechanical heating. On a drop in zone temperature below the heating setpoint, the reheat coil will modulate to maintain the discharge air temperature setpoint. The discharge air temperature setpoint will be reset as the zone temperature changes. The primary air damper is controlled to provide a minimum CFM.
- B. Unoccupied mode: When in this mode, while the zone temperature is between the unoccupied heating and cooling setpoints, the primary air damper will be at the minimum CFM and there will be no mechanical heating. On a rise in zone temperature above the unoccupied cooling setpoint, the primary air damper will increase the CFM (if available) and there will be no mechanical heating. On a drop in zone temperature below the unoccupied heating setpoint, the reheat coil will be used to maintain the zone temperature, and the damper will remain fully closed.
- C. Unit enable: A network unit enable signal will control the mode of the box.



Control logic for VAV reheat zone

END OF SECTION 230900

D.

SECTION 23 2113

HYDRONIC 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 pipe and fitting materials and joining methods for the following:
 - 1. Hot-water heating piping.
 - 2. Chilled-water piping.
 - 3. Condenser-water piping.
 - 4. Makeup-water piping.
 - 5. Condensate-drain piping.
 - 6. Air-vent piping.
 - 7. Dielectric fittings.

1.3 SEISMIC REQUIREMENTS

- A. All other components shall be assigned a component importance factor, Ip, equal to 1.0.
- B. Seismic Performance: Pipe hangers and supports shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Division 23 Section "Vibration and Seismic Controls for HVAC."
 - 1. For piping with a seismic importance factor of 1.0 the term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified."
 - 2. For piping with a seismic importance factor of 1.5 the term "withstand" means "the system 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."

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Steel pipe and fittings.
 - 2. Copper pipe, tubing and fittings.
 - 3. Dielectric fittings.

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 4.1: For solvent cements and adhesive primers, documentation indicating that products 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."

C. 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.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Piping layout, 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. Other building services.
 - 3. Structural members.
- B. Qualification Data: For Installer.
- C. Welding certificates.
- D. Field quality-control reports: Written reports as specified in Part 3 of this section including:
 - 1. Test procedures used.
 - 2. Test results showing compliance with specified requirements.
 - 3. Failed test results with corrective action taken to achieve compliance with specified requirements.

1.6 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code Steel."
- B. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 - 1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

1.7 COORDINATION

- A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate pipe sleeve installations for foundation wall penetrations.
- C. Coordinate piping installation with roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 07 Sections.

- D. Coordinate pipe fitting pressure classes with products specified in related sections.
- E. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 03 Sections.
- F. Coordinate installation of pipe sleeves for penetrations through exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 07 Section "Penetration Firestopping" for fire and smoke wall and floor assemblies.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. Grooved, Mechanical-Joint, Wrought-Copper Fittings: ASME B16.22.
 - 1. Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting.
 - 2. Grooved-End-Tube Couplings: Coupling housings shall be cast with offsetting, angle-pattern bolt pads to provide joint rigidity and support and hanging in accordance with ANSI B31.1 and B31.9. Ductile-iron housing with keys matching pipe and fitting grooves, EPDM gasket rated for minimum 230 deg F without use of special lubricants. For use with housing, and ASTM A449 electroplated steel nuts and bolts.

2.2 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53, 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-Steel Fittings: ASTM A 234, wall thickness to match adjoining pipe.
- G. 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.
- H. Forged Steel "Olet" Type Fittings, Welding, Socket-Welding and Threaded: ASME B16.11 and ASTM A105.
 - 1. 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.

- I. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.
- J. Grooved Mechanical-Joint Fittings and Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following provide products by one of the following:
 - a. Victaulic Company.
 - b. Anvil International, Inc.
 - c. Tyco-Grinnel
 - 2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 53, Type F, E, or S, Grade B factory-fabricated steel; or ASTM A 234, Grade WPB steel fittings with grooves or shoulders designed and constructed to accept grooved-end couplings.
 - 3. Couplings: Two Ductile- housing and synthetic rubber gasket of central cavity pressureresponsive design; with ASTM A449 electroplated steel nuts and bolts to secure grooved pipe and fittings. Couplings shall comply with ASTM F1476 Standard Specification for the Performance of Gasketed Mechanical Couplings for Use in Piping Applications.
 - Rigid Type: Coupling housings shall be cast with offsetting, angle-pattern bolt pads to provide joint rigidity and support and hanging in accordance with ANSI B31.1 and B31.9.
 - b. Gasket: High temperature EPDM gasket, suitable for water service to +250 deg F, without use of special lubricants.
 - c. Flexible Type: For use in locations where vibration attenuation and stress relief are required, and for the elimination of flexible connectors.
 - d. 14" and Larger: Two –segment coupling, with lead-in chamfer on housing key and a wide-width gasket having a center-leg.
 - 4. Combinations of grooved mechanical-joint couplings and short nipples may also be used.

2.3 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. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel. Use of flux is required in all brazing applications. The flux used is to be a black brazing flux that does not contain boric acid and conforms to AWS A5.31 class FB3-C.
- E. 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.

2.4 DIELECTRIC FITTINGS

- A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.Capitol Manufacturing Co.
 - c. Capitol Manufacturing Company.
 - d. Central Plastics Company.
 - e. Elster Perfection.
 - f. Grinnell Mechanical Products.
 - g. Matco-Norca.
 - h. Pipeline Seal and Insulator, Inc.
 - i. Precision Plumbing Products, Inc.
 - j. Victaulic Company.
 - k. Watts Regulator Co.
 - I. Zurn Industries, LLC.
- B. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.
- C. Insulating Material: Suitable for system fluid, pressure, and temperature.
- D. End Connections: Threaded, or flanged.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- F. Dielectric Nipples or Waterways: Electroplated steel with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Hot-water heating piping, aboveground, NPS 2 and smaller shall be any of the following:
 - 1. Type L drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
 - 2. Schedule 40, Grade B, Type 96 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
- B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:
 - 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
 - 2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
 - 3. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
- C. Chilled-water piping, aboveground, NPS 2 and smaller, shall be any of the following:
 - 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
 - 2. Schedule 40, Grade B, Type 96 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

- D. Chilled-water piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:
 - 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
 - 2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
 - 3. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
- E. Condenser-water piping, aboveground, NPS 2 and smaller, shall be any of the following:
 - 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
 - 2. Schedule 40, Grade B, Type 96 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
- F. Condenser-water piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:
 - 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
 - 2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
 - 3. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
- G. Condenser-water piping installed belowground and within slabs shall be **any of** the following:
 - 1. Type K, annealed-temper copper tubing, wrought-copper fittings, and **brazed** joints. Use the fewest possible joints.
 - 2. PP, SDR 7.4 pipe; fusion socket fittings; and fusion joints or butt-fusion joints.
 - 3. PP, SDR 11 fiberglass composite reinforced pipe; fusion socket fittings; and fusion joints or butt-fusion joints.
 - 4. RTRP and RTRF with adhesive or flanged joints.
- H. Glycol cooling-water piping, aboveground, NPS 2 and smaller, shall be any of the following:
 - 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
 - 2. Schedule 40, Grade B, Type 96 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
- I. Glycol cooling-water piping, aboveground, NPS 2-1/2 and larger, shall be any of the following:
 - 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
 - 2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
 - 3. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
- J. Makeup-water piping installed aboveground shall be the following:
 - 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- K. Condensate-drain piping shall be the following:
 - 1. Type M, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- L. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

M. Air-Vent Piping:

- 1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.
- 2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.
- N. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

3.2 PIPING INSTALLATIONS

A. PRE-WORK / PRE-REQUISITES

- 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.
- 2. The Contractor shall study the architectural, structural, mechanical, electrical and other drawings to eliminate conflict of piping with other structure lighting or other services.

B. CONDITION

- 1. All installed pipe lines shall be free from dents, scars, and burrs, with ends reamed smooth.
- 2. All piping shall be clean and free from acids and loose dirt when installed and shall be kept clean during the completion of the installation.
- 3. Install piping free of sags and bends.
- 4. All installed pipe lines shall remain straight against strains tending to cause distortion during system operation. The contractor shall make proper allowance for pipe line expansion and contraction so that no unsightly distortion, noise, damage or improper operation results therefrom.

C. SELECTION

- 1. Select system components with pressure rating equal to or greater than system operating pressure.
- 2. No street type fittings shall be used.
- 3. No short nipples shall be used except at drain valves.
- 4. Plugs of rags, wools, cottons, waste, or similar materials may not be used for plugging.

D. ROUTING/ARRANGEMENT

- 1. Piping installations shall be neatly organized.
- 2. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- 3. Install groups of pipes parallel to each other.
- 4. Install piping spaced to permit application of insulation.

- 5. Install piping parallel and spaced to permit the servicing of valves.
- 6. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls or axis of the building.
- 7. Diagonal runs are prohibited unless specifically indicated otherwise.
- 8. Install fittings for all changes in direction.
- 9. No piping shall be run above any electrical panels, electrical equipment or access clearances for electrical for electrical panels or equipment. No piping shall be allowed to run through any electrical rooms.
- 10. Piping shall be arranged, placed and installed to facilitate equipment maintenance and shall be so arranged to not interfere with the installation of the air-conditioning equipment, ducts, or the removal of other equipment or devices. All specialties shall be so placed to permit easy operation and access.
- 11. All piping shall be so installed to insure noiseless circulation.
- 12. Install fittings for all branch connections.
- 13. Unless otherwise indicated, install branch connections to mains using [mechanically formed] tee fittings or forged steel branch fittings in main pipe, with the branch connected to the bottom of the main pipe.
- 14. For up-feed risers, connect the branch to the top of the main pipe.
- 15. Forged branch fittings shall be installed per the manufacturer's recommendations.

E. ACCESS / ARRANGEMENT

- 1. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal. All piping shall be so arranged to not block access to manholes, access openings, etc.
- 2. Install piping at indicated slopes. If not indicated, install piping at a uniform grade of 0.2 percent where possible, upward in direction of flow. Traps are to be avoided where-ever possible.
- 3. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- 4. When insulated pipes are supported by a roller hanger they shall be protected from damage by suitable pipe covering protection saddles. Saddles shall support pipe on roller and shall be packed with insulation.
- 5. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."
- 6. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, at each coil on all sides of automatic valves where valves do not have union connections, elsewhere as indicated, and wherever necessary to prevent undue difficulty in making repairs or replacement. Unions are not required at flanged connections.
- 7. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated. Install flanges on valves, apparatus, and equipment having 2 ½ inch NPS and larger connections. Flanges or unions as applicable for the type of piping specified, shall be provided in the piping at connections to all items of equipment.
- 8. Install shutoff valve immediately upstream of each dielectric fitting. Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

- 9. Comply with requirements in Division 23 Section "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides. Anchor piping for proper direction of expansion and contraction.
- 10. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."
- Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."
- 12. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section "Escutcheons for HVAC Piping."
- 13. Install strainers on supply side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS ³/₄) nipple and ball valve in blow-down connection of strainers NPS 2) and larger. Match size of strainer blow-off connection for strainers smaller than NPS 2).
- 14. Install flexible connectors at inlet and discharge connections to pumps (except inline pumps) and other vibration-producing equipment.
- 15. Polypropylene pipe in or passing through plenums must be fire wrapped or installed in a metal conduit.

F. DRAINAGE

- 1. Drain valves shall be installed at all low points in all piping systems to allow for complete drainage of piping systems.
- 2. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- 3. All piping systems shall be installed so that they can be easily drained by means of drainage of low points of all piping without disconnecting pipe.
- 4. If not specifically indicated on the drawings, the frequency of draining shall determine whether drain caps, plugs, cocks, or valves are to be used.

G. IDENTIFICATION

1. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for identifying piping.

3.3 DIELECTRIC FITTING INSTALLATION

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

- 3. Install Dielectric Fittings into Hydronic Piping Systems: Install dielectric nipples, waterways or couplings to connect piping materials of dissimilar metals.
- 4. End Connections: Threaded, or flanged.

3.4 HANGERS AND SUPPORTS

- A. Comply with requirements in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.
- Comply with requirements in Division 23 Section "Vibration and Seismic Controls for HVAC" for seismic restraints.
- C. Steel roof deck shall not be used to support loads from piping, ductwork or equipment, unless noted otherwise. Hanger loads less than 50 lbs. may be hung from the steel roof deck in cases when hanging from the steel roof deck cannot be avoided; the attachment method must distribute the load across the deck as approved by the Structural Engineer.
- D. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
 - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet 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.
- E. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
 - 2. NPS 1: Maximum span, 7 feet; minimum rod size, 3/8 inch.
 - 3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 - 4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 1/2 inch.
 - 6. NPS 3 and Larger: Maximum span, 12 feet; minimum rod size, 1/2 inch.
- F. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
 - 2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
 - 3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
 - 4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 - 5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 - 6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 - 7. NPS 3 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.
- G. Fiberglass 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.
- H. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

 Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

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 leadfree 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.
- 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. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- H. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts.
 - 1. 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.
 - 2. Installed in accordance with the manufacturer's written recommendations.
 - 3. Ends shall be clean and free from indentations, projections or roll marks.
 - 4. The gasket shall be molded and produced by the coupling manufacturer of an elastomer suitable for the intended service.
 - 5. Unions and flanges for servicing and disconnect are not required in installations using grooved joint couplings.
 - 6. Training: The coupling manufacturer's factory-direct trained representative shall provide on-site training for the contractor's field personnel in the use of grooving tools and installation of product. The representative shall periodically visit the job site to ensure best practices in grooved product installation are being followed. The distributor's representative will not be acceptable.

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.

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:

- 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

SECTION 23 2116

HYDRONIC 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 special-duty valves and specialties for the following: Hot-water heating piping.
 - Chilled-water piping.
 - 2. Condenser-water piping.
 - 3. Makeup-water piping.
 - 4. Condensate-drain piping.
 - 5. Air-vent piping.
 - 6. Steel, hydronic buffer tanks.

1.3 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.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-control devices, hydronic specialties, and specialduty valves to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 - 1. 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 VALVES

A. Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping." Gate valves are not allowed on this project.

- B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC."
- C. Refer to Part 3 "Valve Applications" Article for applications of each valve.
- D. Bronze, Calibrated-Orifice or Venturi, Balancing Valves, NPS 2 and smaller:
 - Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett Domestic Pump.
 - c. Flow Design Inc.
 - d. Gerand Engineering Co.
 - e. Griswold Controls.
 - f. Taco.
 - g. Tour & Andersson; available through Victaulic Company.
 - h. Tyco-Grinnell
 - 2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
 - 3. Ball: Brass or stainless steel.
 - 4. Plug: Resin.
 - 5. Seat: PTFE.
 - 6. End Connections: Threaded or socket.
 - 7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 - 8. Handle Style: Lever, with memory stop to retain set position.
 - 9. CWP Rating: Minimum 125 psig.
 - 10. Maximum Operating Temperature: 250 deg F.
- E. Cast-Iron or Steel, Calibrated-Orifice or Venturi, Balancing Valves, NPS 2 ½ and larger:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Flow Design Inc.
 - e. Gerand Engineering Co.
 - f. Grinnell.
 - g. Griswold Controls.
 - h. Taco.
 - i. Tour & Andersson; available through Victaulic Company.
 - j. Spence Engineering Company Inc.
 - k. Watts Regulator Co.
 - 2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
 - 3. Ball: Brass or stainless steel.
 - 4. Stem Seals: EPDM O-rings.
 - 5. Disc: Glass and carbon-filled PTFE.
 - 6. Seat: PTFE.
 - 7. End Connections: Flanged or grooved.
 - 8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 - 9. Handle Style: Lever, with memory stop to retain set position.
 - 10. CWP Rating: Minimum 125 psig.
 - 11. Maximum Operating Temperature: 250 deg F.

- F. Diaphragm-Operated, Pressure-Reducing Valves: ASME labeled.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Conbraco Industries, Inc.
 - e. Spence Engineering Company, Inc.
 - f. Watts Regulator Co.
 - 2. Body: Bronze or brass.
 - 3. Disc: Glass and carbon-filled PTFE.
 - 4. Seat: Brass.
 - 5. Stem Seals: EPDM O-rings.
 - 6. Diaphragm: EPT.
 - 7. Low inlet-pressure check valve.
 - 8. Inlet Strainer: Brass, removable without system shutdown.
 - 9. Valve Seat and Stem: Noncorrosive.
 - 10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.
- G. Diaphragm-Operated Safety Valves: ASME labeled.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Conbraco Industries, Inc.
 - e. Kunkle.
 - f. Spence Engineering Company, Inc.
 - 2. Body: Bronze or brass.
 - 3. Disc: Glass and carbon-filled PTFE.
 - 4. Seat: Brass.
 - 5. Stem Seals: EPDM O-rings.
 - 6. Diaphragm: EPT.
 - 7. Wetted, Internal Work Parts: Brass and rubber.
 - 8. Inlet Strainer: Brass, removable without system shutdown.
 - 9. Valve Seat and Stem: Noncorrosive.
 - 10. 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.
- H. Automatic Flow-Control Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett Domestic Pump.
 - c. Flow Design Inc.
 - d. Griswold Controls.
 - e. Taco
 - f. Nexus.

- 2. Body: Brass or ferrous metal.
- 3. Piston and Spring Assembly: Tamper proof, self-cleaning, and removable, for inspections and replacement.
 - a. Corrosion resistant.
- 4. Combination Assemblies: Include bronze or brass-alloy ball valve.
- 5. Identification Tag: Attached by chain and marked with zone identification, valve number, and flow rate.
- 6. Size: Same as pipe in which installed.
- 7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations:
 - a. Minimum CWP Rating: 175 psig.
- 8. Maximum Operating Temperature: 200 deg F.
- 9. Fitted with pressure and temperature test valves.
- 10. Equipped with a readout kit including flow meter, probes, hoses, flow charts, and carrying case.

2.2 AIR-CONTROL DEVICES

A. Manual Air Vents:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Taco, Inc.
- 2. Body: Bronze.
- 3. Internal Parts: Nonferrous.
- 4. Operator: Screwdriver or thumbscrew.
- 5. Manually operated with ball valve in the down position.
- 6. Inlet Connection: NPS 1/2.
- 7. Discharge Connection: NPS 1/8.
- 8. CWP Rating: 150 psig.
- 9. Maximum Operating Temperature: 225 deg F.

B. Automatic Air Vents:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Bell & Gossett Domestic Pump.
 - c. Hoffman Specialty ITT; Fluid Handling Div.
 - d. Spirax-Sarco.
 - e. Spirovent.
 - f. Taco, Inc.
 - g. Honeywell-Baukman.
- 2. Body: Bronze or cast iron.
- Internal Parts: Nonferrous.
- 4. Operator: Noncorrosive metal float.
- 5. Inlet Connection: NPS 1/2.
- 6. Discharge Connection: NPS 1/4.

- 7. CWP Rating: 150 psig.
- 8. Maximum Operating Temperature: 240 deg F.

C. Bladder -Type Expansion Tanks:

- Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Taco. Inc.
 - e. Zilmet
- 2. Tank: Welded steel, rated for 125-psig working pressure and 240 deg F maximum operating temperature. Factory test after taps are fabricated and supports installed and are labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- 3. Bladder : Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
- 4. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.
- 5. Access: Drain fitting and taps for pressure gage.
- 6. Support:
 - a. Vertical tanks with steel legs or base.
 - b. Horizontal tanks with steel saddles.

D. Tangential-Type Air Separators:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Taco, Inc.
- 2. Tank: Welded steel; ASME constructed and labeled for 125-psig minimum working pressure and 240 deg F maximum operating temperature.
- 3. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
- 4. Tangential Inlet and Outlet Connections: Threaded for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger.
- 5. Blowdown Connection: Threaded.
- 6. Size: Match system flow capacity.

2.3 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong Machine Works.
 - b. Hoffman Specialty ITT; Fluid Handling Div.
 - c. Metraflex Co.
 - d. Mueller

- e. Spirax Sarco.
- f. Trane Co.
- g. Tyco-Grinnell.
- h. Tour & Andersson; available through Victaulic Company.
- i. Watts Regulator Co.
- 2. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
- 3. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
- 4. Strainer Screen: Stainless-steel, or perforated stainless-steel basket:
 - a. 20-mesh strainer.
- 5. CWP Rating: 125 psig.

B. Basket Strainers:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.
 - b. Metraflex Co.
 - c. Mueller
 - d. Spirax Sarco.
 - e. Tyco-Grinnell.
 - f. Tour & Andersson; available through Victaulic Company.
- 2. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
- 3. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
- 4. Strainer Screen: Perforated stainless-steel basket with 50 percent free area:
 - a. 40-mesh startup strainer.
- 5. CWP Rating: 125 psig.
- C. Stainless-Steel Braided-Corrugated, Flexible Connectors:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amber-Booth.
 - b. Mason Industries.
 - c. Metraflex Co.
 - d. Flex-Weld.
 - e. Fugate.
 - f. Twin City Hose.
 - 2. Body: 321 Stainless-steel close pitch corrugated hose with woven, flexible, 304 Stainless-steel, protective jacket.
 - 3. End Connections: Flanged, ANSI Class 150 carbon steel
 - 4. Performance: Permanent Offset; 3/8 inch, Intermittent Offset; 1/8 inch.
 - 5. Safe Working Pressure: 175 psig. (For 8 inch diameter)
 - 6. Maximum Operating Temperature: 200 deg F. (For 8 inch diameter)
- D. Spherical, Rubber, Flexible Connectors:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Amber-Booth.
- b. Mason Industries.
- c. Metraflex Co.
- d. Flex-Weld.
- e. Proco.
- f. Fugate.
- g. Twin City Hose.
- 2. Body: Double-sphere fiber-reinforced EPDM rubber body.
- 3. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
- 4. Performance: Capable of misalignment.
- 5. CWP Rating: 150 psig.
- 6. Maximum Operating Temperature: 250 deg F.

E. Diverting Fittings:

- Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump.
 - d. Taco, Inc.
- 2. Body: Cast Iron or Wrought Copper
- 3. Ends: Threaded or Soldered
- 4. Flow Direction: Indicated on fitting.
- 5. CWP Rating: 125 psig.
- 6. Maximum Operating Temperature: 250 deg F.

2.4 STEEL, HYDRONIC BUFFER TANKS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hanson Tank
 - 2. Lochinvar Corporation.
 - Taco Comfort Solutions
 - 4. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 - 5. Weben-Jarco, Inc.
 - 6. Wessels Company.
- B. Description: Steel, horizontal or vertical buffer tank, pressure-rated tank with cylindrical sidewalls. See drawings for tank type.
- C. Fabricate supports and attachments to tank with reinforcement strong enough to resist tank movement during seismic event when tank supports are anchored to building structure.
- D. Construction:
 - 1. ASME Boiler and Pressure Vessels Code Section VIII code, steel, constructed with welded joints, 450°F temperature and a pressure rating of:
 - a. 125 PSIG
- E. Manhole: Watertight, for tank more than 36 inches in diameter; same pressure rating as tank.
- F. Tappings: Factory-fabricated, welded to tank before testing and labeling.
 - 1. Hot water buffer tanks shall have four tappings.
 - a. NPS 2 and Smaller: ASME B1.20.1, with female thread.

- b. NPS 2-1/2 and Larger: ASME B16.5, flanged.
- 2. Chilled water buffer tanks shall have two tappings.
 - a. NPS 2 and Smaller: ASME B1.20.1, with female thread.
 - b. NPS 2-1/2 and Larger: ASME B16.5, flanged.
- G. Specialties and Accessories: Include tappings in tank and the following:
 - 1. Pressure gage.
 - 2. Thermometer.
- H. Horizontal Tank Supports: Factory-fabricated steel saddles, welded to tank before testing and labeling.
- I. Vertical Tank Supports: Factory-fabricated steel legs or steel skirt, welded to tank before testing and labeling.
- J. Exterior Coating: Manufacturer's standard enamel paint.
- K. Insulation: Factory-installed fiberglass or polyurethane foam; surrounding entire tank except connections and other openings; suitable for tank operating temperature; and complying with ASHRAE/IESNA 90.1.
- L. Jacket: Steel, with manufacturer's standard finish unless otherwise indicated.

PART 3 - EXECUTION

3.1 VALVE APPLICATIONS

- A. Install shut off-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. Automatic air vents may cause damage to ceilings and other finished surfaces. Air vents aid in system filling. Air removal after initial startup is accomplished by air separator or boiler dip tube. Manual air vents may be a better solution.
- C. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat-transfer coils and elsewhere as required for air venting.

- D. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- E. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 and larger.
- F. Install tangential air separator in pump suction. Install blowdown piping with full-port ball valve; extend full size to nearest floor drain.
- G. 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.
- H. 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.
- I. Install buffer tanks on the floor per manufacturer's instructions.

END OF SECTION

SECTION 23 3001

COMMON DUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Includes But Not Limited To:
 - 1. General procedures and requirements for ductwork.
 - 2. Repair leaks in ductwork, as identified by smoke test, at no additional cost to Owner.
 - 3. Soundproofing procedures for duct penetrations of walls, ceilings, and floors in mechanical equipment rooms.

B. Related Sections:

Division 07: Quality of Acoustic Sealant.
 Section 23 0500: Common Work Results for HVAC

3. Section 23 0593: Testing Adjusting and Balancing for HVAC.

1.2 SUBMITTALS

- A. Samples: Sealer and gauze proposed for sealing ductwork.
- B. Quality Assurance / Control:
 - 1. Manufacturer's installation manuals providing detailed instructions on assembly, joint sealing, and system pressure testing for leaks.
 - 2. Specification data on sealer and gauze proposed for sealing ductwork.

1.3 QUALITY ASSURANCE

- A. Requirements: Construction details not specifically called out in Contract Documents shall conform to applicable requirements of SMACNA HVAC Duct Construction Standards.
- B. Pre-Installation Conference: Schedule conference immediately before installation of ductwork.

PART 2 - PRODUCTS

2.1 Finishes, Where Applicable: Colors as selected by Architect.

2.2 Duct Hangers:

- A. One inch by 18 ga galvanized steel straps or steel rods as shown on Drawings, and spaced not more than 96 inches apart. Do not use wire hangers.
 - Attaching screws at trusses shall be 2 inch No. 10 round head wood screws. Nails not allowed.

- 2. Attach threaded rod to steel joist with Grinnell Steel washer plate Fig. 60 ph-1. Double nut connection.
- 2.3 Penetration Soundproofing Materials:
 - A. Insulation for Packing: Fiberglass.
 - B. Calking: Polysulphide.
 - C. Escutcheon Frame: 22 ga galvanized iron 2 inches wide.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. During installation, protect open ends of ducts by covering with plastic sheet tied in place to prevent entrance of debris and dirt.
- B. Make necessary allowances and provisions in installation of sheet metal ducts for structural conditions of building. Revisions in layout and configuration may be allowed, with prior written approval of Architect. Maintain required airflows in suggesting revisions.
- C. Hangers And Supports:
 - 1. Install upper ends of hanger securely to floor or roof construction above by method shown on Drawings.
 - 2. Attach strap hangers to ducts with cadmium-plated screws. Use of pop rivets or other means will not be accepted.
 - 3. Where hangers are secured to forms before concrete slabs are poured, cut off flush all nails, strap ends, and other projections after forms are removed.
 - 4. Secure vertical ducts passing through floors by extending bracing angles to rest firmly on floors without loose blocking or shimming. Support vertical ducts, which do not pass through floors, by using bands bolted to walls, columns, etc. Size, spacing, and method of attachment to vertical ducts shall be same as specified for hanger bands on horizontal ducts.

D. Penetration Soundproofing

- 1. Pack space between ducts and structure full of fiberglass insulation of sufficient thickness to be wedged tight, allowing space for application of calking.
- 2. Provide calking at least 2 inches thick between duct and structure on both ends of opening through structure.
- 3. Provide metal escutcheon on Equipment Room side. Secure escutcheon to wall.

3.2 CLEANING

A. Clean interior of duct systems before final completion.

3.3 CROSS OVER LADDER

A. All ductwork and piping at walking level that must be crossed for equipment maintenance and service shall have a cross-over ladder.

END OF SECTION

SECTION 23 31 13

METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Single-wall rectangular ducts and fittings.
- 2. Double-wall rectangular ducts and fittings.
- 3. Single-wall round and flat-oval ducts and fittings.
- 4. Double-wall round and flat-oval ducts and fittings.
- Exhaust Air Stacks
- 6. Guy wires and connectors.
- 7. Sheet metal materials.
- 8. Duct liner.
- 9. Sealants and gaskets.
- 10. Hangers and supports.

B. Related Sections:

- 1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
- 2. Section 233119 "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
- 3. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
- 4. Section 230713 "Duct Insulation" for duct insulation and fire wrap.
- C. Stacks from the exhaust systems are to be designed per SMACNA guidelines. Use the "Guide for steel stack design and Construction" the latest edition. The outside of the stacks are to be painted with Pota-Pox. 80 series 141 material. Color is to be selected by the architect. Provide guy wires and angle supports. Construction shall be a minimum of 10 gauge and shall be painted on the inside of the stack and on the exterior where the stack is exterior to the building.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Seismic Performance: Duct hangers and supports shall withstand the effects of earthquake motions determined according to SEI/ASCE 7 and with the requirements specified in Section 230548 "Vibration and Seismic Controls for HVAC."

- 1. For equipment with a seismic importance factor of 1.0 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."
- 2. For equipment with a seismic importance factor of 1.5 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."
- C. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards Metal and Flexible"
- D. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Liners and adhesives.
 - 2. Sealants and gaskets.
 - 3. Seismic-restraint devices.

B. LEED Submittals:

- 1. Product Data for Prerequisite IEQ 1: Documentation indicating that duct systems comply with ASHRAE 62.1, Section 5 "Systems and Equipment."
- 2. Product Data for Prerequisite EA 2: Documentation indicating that duct systems comply with ASHRAE/IESNA 90.1, Section 6.4.4 "HVAC System Construction and Insulation."
- 3. Leakage Test Report for Prerequisite EA 2: Documentation of work performed for compliance with ASHRAE/IESNA 90.1, Section 6.4.4.2.2 "Duct Leakage Tests."
- 4. Duct-Cleaning Test Report for Prerequisite IEQ 1: Documentation of work performed for compliance with ASHRAE 62.1, Section 7.2.4 "Ventilation System Start-up."
- 5. Laboratory Test Reports for Credit IEQ 4: For adhesives and 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."
- 6. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.

C. Shop Drawings:

- 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
- 2. Factory- and shop-fabricated ducts and fittings.
- 3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
- 4. Elevation of top of ducts.
- 5. Dimensions of main duct runs from building grid lines.
- 6. Fittings.
- 7. Reinforcement and spacing.
- 8. Seam and joint construction.
- 9. Penetrations through fire-rated and other partitions.
- 10. Equipment installation based on equipment being used on Project.
- 11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.

- 12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.
- 13. Duct fabrication shall not begin until shop drawings have been submitted and reviewed by the mechanical engineer.

D. Delegated-Design Submittal:

- Sheet metal thicknesses.
- 2. Joint and seam construction and sealing.
- 3. Reinforcement details and spacing.
- 4. Materials, fabrication, assembly, and spacing of hangers and supports.
- 5. Design Calculations: Calculations for selecting hangers and supports.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 - 2. Suspended ceiling components.
 - 3. Structural members to which duct will be attached.
 - 4. Size and location of initial access modules for acoustical tile.
 - 5. Penetrations of smoke barriers and fire-rated construction.
 - 6. Items penetrating finished ceiling including, but not limited to the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Perimeter moldings.
- B. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code Steel," for hangers and supports. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code Steel," for hangers and supports.
 - 2. AWS D1.2/D1.2M, "Structural Welding Code Aluminum," for aluminum supports.
 - 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 "Systems and Equipment" and Section 7 "Construction and System Start-up."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards Metal and Flexible."
- D. Duct dimensions shown on drawings are inside clear dimensions.
- E. 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."

2.2 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.
- B. Duct dimensions shown on drawings are inside clear dimensions.
- C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- D. 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."
- E. 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."
- F. 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 Fat 75 deg F 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.
- G. 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 at 75 deg F mean temperature.
- H. Inner Duct: Minimum 0.028-inchsolid sheet steel.
- I. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 2-1, "Rectangular Duct/Traverse 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."
- J. 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."

2.3 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
- B. Duct dimensions shown on drawings are inside clear dimensions.
- C. 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).
- D. 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 in Diameter: Flanged.
- E. Longitudinal Seams: Not allowed.
- F. 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. 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.
- B. Duct dimensions shown on drawings are inside clear dimensions.

- 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.
 - 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 in Diameter: Flanged.
 - 2. Longitudinal Seams: Not allowed.
 - 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 solid sheet steel.
 - 1. Perforated inner ducts exposed to air movement shall not be used in supply air ducts upstream of the following rooms: Operating rooms, trauma rooms, LDR rooms, NICU nurseries, ICU nurseries, positive pressure isolation rooms, cath labs, bone marrow, triage rooms, angiogram rooms, fluoroscopy rooms, linear accelerators, decontamination areas and any invasive procedure rooms where the duct insulation could be a source of contamination.
 - 2. Inner duct shall be solid sheet steel a minimum of 10 feet downstream of humidifiers and/or air washers.
- 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 at 75 deg F 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 Fat 75 deg F mean temperature.

2.5 EXHAUST AIR STACKS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support

intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- C. Longitudinal Seams: Not allowed.
- 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."
- E. Design Wind Loads: 150 mph.
- F. Design for seismic conditions at Project site.
- G. Accessories: Terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as duct straight sections.
 - 1. Termination: Antibackdraft damper.
- H. Drain: Provide drain section incorporated into base of stack with trap. Seal depth design to prevent seal blowout at highest estimated static pressure.
- I. Guying and Bracing Materials
 - 1. Cable: Three minimum galvanized or stainless steel, stranded wires of the following thickness: [Four] <Insert number> [stainless steel]
 - a. Minimum Size: 1/4 inch in diameter.
 - b. For ID Sizes 4 to 15 Inches: 5/16 inch.
 - c. For ID Sizes 18 to 24 Inches: 3/8 inch.
 - d. For ID Sizes 27 to 30 Inches: 7/16 inch.
 - e. For ID Sizes 33 to 36 Inches: 1/2 inch.
 - f. For ID Sizes 39 to 48 Inches: 9/16 inch.
 - g. For ID Sizes 51 to 60 Inches: 5/8 inch.
 - 2. Cable Hardware: Provide duct angle ring, turnbuckles, cable loop thimbles, cable clamps and all hardware necessary to brace stack.
 - 3. Pipe: Two galvanized steel, NPS 1-1/4. [Three].
 - 4. Angle Iron: Two galvanized steel, 2 by 2 by 0.25 inch. [Three].

2.6 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.
 - 1. Galvanized Coating Designation: G90.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008, with oiled, matte finish for exposed ducts.

- D. Reinforcement Shapes and Plates: ASTM A 36, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- E. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.7 DUCT LINER

A. Per ASHRAE Standard 170 section 6.9 duct liner shall not be installed in ductwork downstream of filter bank #2 for this project.

2.8 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: 4 inches.
 - 3. Sealant: Modified styrene acrylic.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 - 7. Service: Indoor and outdoor.
 - 8. Service Temperature: Minus 40 to plus 200 deg F.
 - 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).
 - 11. 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."
- 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, positive and negative.
 - 8. Service: Indoor or outdoor.
 - 9. Substrate: Compatible with galvanized sheet steel, stainless steel, or aluminum sheets.
- D. Solvent-Based Joint and Seam Sealant:
 - 1. Application Method: Brush on.

- 2. Base: Synthetic rubber resin.
- 3. Solvent: Toluene and heptane.
- 4. Solids Content: Minimum 60 percent.
- 5. Shore A Hardness: Minimum 60.
- 6. Water resistant.
- 7. Mold and mildew resistant.
- 8. 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).
- 9. VOC: Maximum 395 g/L.
- 10. 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."
- 11. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
- 12. Service: Indoor or outdoor.
- 13. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- E. Flanged Joint Sealant: Comply with ASTM C 920.
 - 1. General: Single-component, acid-curing, silicone, elastomeric.
 - 2. Type: S.
 - 3. Grade: NS.
 - 4. Class: 25.
 - 5. Use: O.
 - 6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- G. Round Duct Joint O-Ring Seals:
 - 1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
 - 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
 - 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.9 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 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 and flat-oval 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 2 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 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".
- M. Where ducts pass through sound-rated walls, fill the opening between the partition and duct with insulation and seal the opening.

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.

3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

- A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.
- B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 12 feet in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches from bottom of duct. [20 feet]. The minimum duct access door size shall be 12' x 12'. Where ductwork is large and can accommodate a larger access door the minimum access door size shall be 18" x 18".
- C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.
- D. Perform a light test of grease ductwork per 2018 International Mechanical Code prior to concealment by insulation or covered by shaft.
 - 1. Perform light test in the presence of local Inspector/Engineer.
 - 2. Document whether test passed or failed.
 - 3. Repair any joints or duct welds that fail light test to the point the ductwork passes the light test.
- E. Install grease duct with minimum clearance to combustibles as required by IBC and local codes. Installations that do not meet the minimum required clearances shall be fire wrapped as specified in Section 230713 "Duct Insulation".
- F. Provide approved fire-wrap insulation that meets ASTM C 656.

3.4 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 A.
- 4. Outdoor, Return-Air Ducts: Seal Class A.
- 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class A.
- 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
- 7. Unconditioned Space, Exhaust Ducts: Seal Class A.
- 8. Unconditioned Space, Return-Air Ducts: Seal Class A.
- 9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class A.
- Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
- 11. Conditioned Space, Exhaust Ducts: Seal Class A.
- 12. Conditioned Space, Return-Air Ducts: Seal Class A.

3.5 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.
 - Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.6 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 the requirements specified in Section 230548 "Vibration and Seismic Controls for HVAC."
 - 1. Comply with ASCE/SEI 7.

3.7 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.

3.8 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.9 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: Test representative duct sections, approved by Engineer from sections installed, totaling no less than 25 percent of total installed duct area for each designated pressure class.
 - b. Supply Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, approved by the Engineer from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
 - c. Return Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, approved by the Engineer from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
 - d. All Exhaust Ducts: Test representative duct sections, approved by the Engineer from sections installed, totaling no less than 50 percent of total installed duct area.
 - e. Outdoor Air Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, approved by the Engineer from sections installed, totaling no less than 50 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.
- 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.
- 3. Any liner showing evidence that is has wet at any time shall be removed and replaced with new liner.
 - a. Disinfect affected sheet metal, and pins.
 - b. Install new liner per specifications
 - c. Seal friable edges and seams of repaired liner.
- D. Duct system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.10 DUCT CLEANING

- A. Clean new duct system before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
 - 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.

3.11 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.12 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel.
- B. Ductwork running in areas where there are no ceilings or when noted on the drawings shall be doubled wall duct and shall meet the requirements indicated below.
- C. BSL-3 Ducts:
 - 1. Supply and exhaust ducts serving BSL-3 areas :
 - a. Type 304 .05-inch thick stainless-steel sheet.
 - 1) Exposed to View: No. 4 finish.
 - 2) Concealed: No. 2B finish.
 - b. Pressure Class: Positive or negative 6-inch wg.
 - c. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - d. SMACNA Leakage Class: 2.
 - e. Supply ducts outside of BSL-3 area shall transition to galvanized.

D. MRI Ducts:

- 1. All ducts Connected to and serving MRI Areas:
 - a. All ductwork shall be aluminum with non-ferrous hardware and accessories.
 - b. Pressure Class: Positive or negative 6-inch wg.
 - c. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.

d. SMACNA Leakage Class: 2.

E. Supply Ducts:

- 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive 2-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 16.
 - d. SMACNA Leakage Class for Round and Flat Oval: 8.
- 2. Ducts Connected to Constant-Volume Air-Handling Units:
 - a. Pressure Class: Positive 3-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 8.
 - d. SMACNA Leakage Class for Round and Flat Oval: 4.
- 3. Ducts Connected to Variable-Air-Volume Air-Handling Units:
 - a. Pressure Class: Positive 6-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 4.
 - d. SMACNA Leakage Class for Round and Flat Oval: 2.
- 4. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive 4-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 4.
 - d. SMACNA Leakage Class for Round and Flat Oval: 2.

F. Return Ducts:

- Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 16.
 - d. SMACNA Leakage Class for Round and Flat Oval: 8.
- 2. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 16.
 - d. SMACNA Leakage Class for Round and Flat Oval: 8.
- 3. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 3-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 8.
 - d. SMACNA Leakage Class for Round and Flat Oval: 4.

G. Exhaust Ducts:

- 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 16.
 - d. SMACNA Leakage Class for Round and Flat Oval: 4.
- 2. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive or negative 3-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 8.
 - d. SMACNA Leakage Class for Round and Flat Oval: 4.
- 3. Ducts Connected to Variable-Air-Volume Air-Handling Units:
 - a. Pressure Class: Positive 6-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 4.
 - d. SMACNA Leakage Class for Round and Flat Oval: 2.
- 4. Ducts Connected to Type I (Grease) Commercial Kitchen Hoods: Comply with NFPA 96.
 - a. Exposed to View: 18 gauge Type 304, stainless-steel sheet, No. 4 finish.
 - b. Concealed: 16 gauge black steel.
 - c. Pressure Class: Positive or negative 3-inch wg.
 - d. Welded seams and joints.
 - e. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - f. SMACNA Leakage Class: 2.
 - g. A light test shall be performed for grease duct prior to concealing the duct.
- 5. Ducts Connected to Type II (Heat) Commercial Kitchen Hoods:
 - a. Type 304, stainless-steel sheet.
 - b. Exposed to View: No. 4 finish.
 - c. Pressure Class: Positive or negative 3-inch wg.
 - d. Concealed: No. 2D finish.
 - e. Welded seams and joints.
 - f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - g. SMACNA Leakage Class: 2.
- 6. Ducts Connected to Dishwasher and Low Temperature Vapor and Odor Hoods:
 - a. Type 304, stainless-steel sheet.
 - b. Exposed to View: No. 4 finish. Pressure Class: Positive or negative 3-inch wg.
 - c. Concealed: No. 2D finish.
 - d. Welded seams and flanged joints with watertight EPDM gaskets.
 - e. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations, flanged joints class A.
 - f. SMACNA Leakage Class: 2.
- 7. Ducts Connected to Fans Exhausting Laboratory and Process (ASHRAE 62.1, Class 3 and 4) Air:

- a. Type 304, stainless-steel sheet.
 - 1) 0.05-inch thick.
 - 2) Exposed to View: No. 4 finish.
 - 3) Concealed: No. 2B finish.
- b. Pressure Class: Positive or negative 6-inch wg.
- c. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
- d. SMACNA Leakage Class: 2.
- e. Main laboratory exhaust trunks to be galvanized steel with same pressure, seal and leakage class.
- 8. Ducts Connected to Cage Wash Areas:
 - a. Type 316 .05-inch thick stainless-steel sheet.
 - 1) Exposed to View: No. 4 finish.
 - 2) Concealed: No. 2B finish.
 - b. Pressure Class: Positive or negative 6-inch wg.
 - c. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - d. SMACNA Leakage Class: 2.
- 9. Ducts Connected to radioactive fume hoods:
 - a. Type 316 .05-inch thick stainless-steel sheet.
 - 1) Exposed to View: No. 4 finish.
 - 2) Concealed: No. 2B finish.
 - b. Pressure Class: Positive or negative 6-inch wg.
 - c. Minimum SMACNA Seal Class: A. Flanged and gasketed joints for future disassembly for decontamination.
 - d. SMACNA Leakage Class: 2.
- 10. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 4-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 4.
 - d. SMACNA Leakage Class for Round and Flat Oval: 2
- H. 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 or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 16.
 - d. SMACNA Leakage Class for Round and Flat Oval: 4.
 - 2. Ducts Connected to Air-Handling Units:
 - a. Pressure Class: Positive or negative 3-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 8.
 - d. SMACNA Leakage Class for Round and Flat Oval: 4.

- 3. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 3-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 8.
 - d. SMACNA Leakage Class for Round and Flat Oval: 4.
- I. Intermediate Reinforcement:
 - 1. Galvanized-Steel Ducts: Galvanized steel.
 - 2. Stainless-Steel Ducts:
 - a. Exposed to Airstream: Match duct material.b. Not Exposed to Airstream: Match duct material.
 - 3. Aluminum Ducts: Aluminum.
- J. Duct Liner Restrictions:
 - 1. Duct liner is not allowed in any ductwork on this project per ASHRAE Standard 170 section 6.9.
- K. Double-Wall Duct Interstitial Insulation:
 - 1. Supply Air Ducts: 1 inch thick.
 - 2. Return Air Ducts: 1 inch thick.
 - 3. Exhaust Air Ducts: 1 inch thick.
- L. Exterior Ductwork Liner Insulation:
 - 1. Supply Air Ducts: 2 inch thick with a minimum R value of 8.0.
 - 2. Return Air Ducts: 2 inch thick with a minimum R value of 8.0.
 - 3. Exhaust Air Ducts: 2 inch thick with a minimum R value of 8.0.
- M. Elbow Configuration:
 - Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards -Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - 2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

- 1) Velocity 1000 fpm or Lower: 1.0 radius-to-diameter ratio and three segments for 90-degree elbow.
- 2) Velocity 1000 to 1500 fpm: 1.5 radius-to-diameter ratio and four segments for 90-degree elbow.
- 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
- 4) Radius-to Diameter Ratio: 1.5.
- b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
- c. Round Elbows, 14 Inches and Larger in Diameter: Welded.

N. 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 high efficiency take-off.
 - b. Rectangular Main to Round Branch: 45-degree entry high efficiency take-off.
- 2. Round and Flat Oval:
 - a. 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.
 - b. Velocity 1000 to 1500 fpm: 45-degree entry high efficiency tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION

SECTION 23 3300

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. Backdraft dampers.
- 2. Pressure relief dampers.
- 3. Barometric relief dampers.
- 4. Manual volume dampers.
- 5. Control dampers.
- 6. Fire dampers.
- 7. Smoke dampers.
- 8. Combination fire and smoke dampers.
- 9. Duct silencers.
- 10. Turning vanes.
- 11. Remote damper operators.
- 12. Duct-mounted access doors.
- 13. Flexible connectors.
- 14. Flexible ducts.
- 15. Duct security bars.
- 16. Duct accessory hardware.
- 17. High efficiency take-offs.

B. Related Requirements:

- 1. Division 23 "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
- 2. Division 23 "Diffusers, Registers and Grilles".
- 3. Division 28 "Digital, Addressable Fire-Alarm System" for duct-mounted fire and smoke detectors.
- 4. Division 28 "Zoned (DC-Loop) Fire-Alarm System" for duct-mounted fire and smoke detectors.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. LEED Submittals:

1. Product Data for Prerequisite IEQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."

- 2. Product Data for Prerequisite EA 2: Documentation indicating that duct insulation R-values comply with tables in ASHRAE/IESNA 90.1, Section 6 "Heating, Ventilating, and Air Conditioning."
- C. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
 - Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control-damper installations.
 - d. Fire-damper, smoke-damper, combination fire- and smoke-damper, pressure relief-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
 - e. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
- B. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in 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. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

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.
 - 1. Galvanized Coating Designation: G60.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- C. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- D. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- E. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 BACKDRAFT DAMPERS

- 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. Greenheck Fan Corporation.
 - 3. Nailor Industries Inc.
 - 4. Pottorff.
 - 5. Ruskin Company.
 - 6. United Enertech
- B. Function:
 - 1. Designed to allow airflow in one direction and prevent reverse airflow.
 - 2. Keeps outside air out of the space by sensing and closing against mass flow.
- C. Description:
 - Gravity balanced.
- D. Maximum Air Velocity:
 - 1. 1000 fpm
- E. Maximum System Pressure:
 - 1. 3-inch wg.
- F. Frame: Hat-shaped, with welded corners or mechanically attached and mounting flange:
 - 1. 16GA 0.063-inch- thick extruded aluminum.
- G. Blades: Multiple single-piece blades, maximum 6-inch width noncombustible, tear-resistant, neoprene-coated fiberglass with sealed edges:
 - 1. Center pivoted: 16GA 0.050-inch- thick aluminum sheet.
- H. Blade Action: Parallel.
- I. Blade Seals: Mechanically locked.
 - 1. Neoprene.
- J. Blade Axles: 0.20 inch diameter:
 - 1. Material: Nonferrous metal.

- K. Tie Bars and Brackets:
 - 1. Aluminum.
- L. Return Spring: Adjustable tension.
- M. Bearings:
 - 1. Synthetic pivot bushings.
- N. Accessories.
 - 1. Adjustment device to permit setting for varying differential static pressure.
 - 2. Counterweights and spring-assist kits for vertical airflow installations.
 - 3. Screen Mounting: Front mounted in sleeve.
 - a. Sleeve Thickness: 20 gage minimum.
 - b. Sleeve Length: 6 inches minimum.
 - 4. Screen Mounting: Rear mounted.
 - 5. Screen Material:
 - a. Aluminum.
 - 6. Screen Type:
 - a. Bird
 - 7. 90-degree stops.

2.4 PRESSURE RELIEF DAMPERS

- 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. Greenheck Fan Corporation.
 - 3. Nailor Industries Inc.
 - 4. Pottorff.
 - 5. Ruskin Company.
- B. Function:
 - 1. Provide component designed to protect HVAC systems by relieving air pressure from within a space that is beyond a pre-determined limit.
 - 2. To automatically begin to open at a pre-set pressure difference above maximum system pressure.
 - 3. Internally self-controlled with system pressure utilizing adjustable arms and weights.
 - 4. Self-actuated with system pressure utilizing adjustable arms and weights.
 - 5. Employs blade counterbalancing.
 - 6. Automatically closes and re-sets when pressures return to normal conditions.
- C. Air Velocity:
 - 1. 3900 fpm.
- D. Maximum System Pressure (MSP):
 - 1. 5-inch wg.
- E. Differential Pressure Preset above MSP:
 - 1. 1-inch wg.
- F. Maximum Damper Pressure Limit:
 - 1. 5.0-inch wg.

- G. Frame Material: Flanged Channel:
 - 1. 14GA 0.079-inch- thick galvanized steel.
- H. Frame Depth: 8-inch- minimum.
- I. Blades:
 - 1. Material:
 - a. 16GA 0.063-inch-formed galvanized steel.
 - 2. Type:
 - Formed Sheetmetal.
 - 3. Blade-stop:
 - a. With stop.
- J. Blade Action: Parallel.
- K. Blade Seals:
 - Thermo Plastic Elastomer.
- L. Blade Axles:
 - Material:
 - a. Plated steel.
 - 2. Diameter: 0.375 inch.
- M. Linkage:
 - External heavy duty type with galvanized steel clevis arms and plated steel tie bars & pivot pins with nylon pivot bearings.
- N. Bearings:
 - 1. Galvanized Steel ball.

2.5 BAROMETRIC RELIEF DAMPERS

- 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. Greenheck Fan Corporation.
 - 3. Nailor Industries Inc.
 - 4. Pottorff.
 - 5. Ruskin Company.
- B. Function:
 - 1. Senses and compares outdoor ambient and indoor pressures.
 - 2. Allows any higher pressure indoor air to escape.
- C. Description: Suitable for horizontal or vertical mounting.
- D. Maximum Air Velocity:
 - 1. 1000 fpm
- E. Maximum System Pressure:
 - 1. 3-inch wg.
- F. Frame: Hat-shaped, with welded corners or mechanically attached and mounting flange.
 - 1. 13GA 0.094-inch- thick, galvanized sheet steel.

- G. Blades: Multiple:
 - 1. 16GA 0.050-inch- thick aluminum sheet.
 - 2. Maximum Width: 6 inches.
 - 3. Action: Parallel.
 - 4. Balance: Gravity.
 - 5. Pivot:
 - a. Eccentric.
- H. Blade Seals:
 - 1. Neoprene
- Blade Axles:
 - 1. Galvanized steel.
- J. Tie Bars and Brackets: Rattle free with 90-degree stop.
 - 1. Material:
 - a. Galvanized steel.
- K. Return Spring: Adjustable tension.
- L. Bearings:
 - 1. Synthetic

2.6 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Warming and Ventilating; a division of Mestek, Inc.
 - b. McGill AirFlow LLC.
 - c. Nailor Industries Inc.
 - d. Pottorff.
 - e. Ruskin Company.
 - f. United Enertech
 - 2. Standard leakage rating, with linkage outside airstream.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames: Hat-shaped, Mitered and welded corners. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - a. 16GA 0.064-inch thick, galvanized sheet steel.
 - 5. Blades:
 - Multiple or single blade. Parallel- or opposed-blade design. Stiffened damper blades for stability.
 - b. Material:
 - 1) Galvanized -steel, 16GA 0.064 inch thick.
 - 6. Blade Axles:
 - a. Nonferrous metal
 - b. Shall extend full length of damper blades in ducts with pressure classes of 3-inch wg or more.
 - 7. Bearings:
 - a. Material:

- Molded synthetic.
- b. Bearings at both ends of damper operating shafts in ducts with pressure classes of 3-inch wg or more.
- 8. Tie Bars and Brackets: Galvanized steel.
- B. Standard, Aluminum, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Warming and Ventilating; a division of Mestek, Inc.
 - b. McGill AirFlow LLC.
 - c. Nailor Industries Inc.
 - d. Pottorff.
 - e. Ruskin Company.
 - f. United Enertech
 - 2. Standard leakage rating, with linkage outside airstream.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with 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. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
 - e. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.
 - 6. Blade Axles: Nonferrous metal.
 - 7. Bearings:
 - a. Molded synthetic.
 - b. Dampers in ducts with pressure classes of 3-inch wg or more shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 8. Tie Bars and Brackets: Aluminum.
- C. Low-Leakage, Steel, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Warming and Ventilating; a division of Mestek, Inc.
 - b. McGill AirFlow LLC.
 - c. Nailor Industries Inc.
 - d. Pottorff.
 - e. Ruskin Company.
 - f. United Enertech
 - 2. Comply with AMCA 500-D testing for damper rating.
 - 3. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
 - 4. Suitable for horizontal or vertical applications.
 - 5. Frames:
 - a. Frame: Hat-shaped,
 - 1) 16GA 0.064-inch thick, galvanized sheet steel.

- b. Mitered and welded corners.
- c. Flanges for attaching to walls and flangeless frames for installing in ducts.

6. Blades:

- a. Multiple or single blade.
- b. Parallel- or opposed-blade design.
- c. Stiffen damper blades for stability.
- d. Material:
 - 1) Galvanized, roll-formed steel, 16GA 0.064 inch thick.
- 7. Blade Axles:
 - Nonferrous metal.
- 8. Bearings:
 - a. Molded synthetic.
 - b. Dampers in ducts with pressure classes of 3-inch wg or more shall have axles full length of damper blades and bearings at both ends of operating shaft.
- 9. Blade Seals:
 - a. Neoprene.
- 10. Jamb Seals: Cambered Stainless steel or aluminum.
- 11. Tie Bars and Brackets: Galvanized steel or aluminum.
- 12. Accessories:
 - Include locking device to hold single-blade dampers in a fixed position without vibration.
- D. Low-Leakage, Aluminum, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Warming and Ventilating; a division of Mestek, Inc.
 - b. Nailor Industries Inc.
 - c. McGill AirFlow LLC.
 - d. Pottorff.
 - e. Ruskin Company.
 - f. United Enertech
 - 2. Comply with AMCA 500-D testing for damper rating.
 - 3. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
 - 4. Suitable for horizontal or vertical applications.
 - 5. Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
 - 6. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
 - d. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.
 - 7. Blade Axles: Nonferrous metal.
 - 8. Bearings:
 - a. Molded synthetic.

- b. Dampers in ducts with pressure classes of 3-inch wg or more shall have axles full length of damper blades and bearings at both ends of operating shaft.
- 9. Blade Seals: Neoprene.
- 10. Jamb Seals: Cambered aluminum.
- 11. Tie Bars and Brackets: Aluminum.
- 12. Accessories:
 - a. Include locking device to hold single-blade dampers in a fixed position without vibration.

E. Jackshaft:

- 1. Size:
 - a. 1-inch diameter.
- 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
- 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

F. Damper Hardware:

- 1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
- 2. Include center hole to suit damper operating-rod size.
- 3. Include elevated platform for insulated duct mounting.

2.7 CONTROL DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Greenheck Fan Corporation.
 - 2. Pottorff.
 - 3. Ruskin Company.
 - 4. Young Regulator Company.
 - 5. United Enertech
- 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. Section:
 - a. Hat shaped.
 - 2. Material:
 - a. 20 GA 0.40-inch- thick galvanized steel .
 - 3. Corners:
 - a. Mitered-and-welded.
- D. Blades: Multiple.
 - 1. Maximum blade width:
 - a. 6 inches.
 - 2. Opposed -blade design.
 - 3. Material:
 - a. Galvanized-steel.

- 4. Thickness:
 - a. 20 GA 0.40-inch- thick galvanized steel
- 5. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.
 - a. Closed-cell neoprene

E. Blade Axles:

- 1. Section:
 - a. 3/8-inch-square
- Material:
 - a. Galvanized steel.
- 3. Blade-linkage hardware:
 - a. Zinc-plated steel and brass.
 - b. Ends sealed against blade bearings:
- 4. Operating Temperature Range: From minus 40 to plus 200 deg F.

F. Bearings:

- 1. Type:
 - a. Molded synthetic.
- 2. Axles: Dampers in ducts with pressure classes of 3-inch wg or more shall have axles full length of damper blades.
- 3. Bearings: Thrust bearings at each end of every blade. Bearings at both ends of each operating shaft.

2.8 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Arrow United Industries; a division of Mestek, Inc.
 - 2. Greenheck Fan Corporation.
 - 3. Nailor Industries Inc.
 - 4. Pottorff.
 - 5. Ruskin Company.
 - 6. United Enertech
- B. Type:
 - 1. Dynamic.
- C. Standard: Rated and labeled according to UL 555 by an NRTL.
- D. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.
- E. Fire Rating:
 - 1. 1-1/2 hours.
- F. Frame:
 - 1. Curtain type with blades outside airstream.
 - Material:
 - a. Fabricated with roll-formed galvanized steel; with mitered and interlocking corners.
 - b. Thickness:
 - 1) 20GA-0.040-inch-.
- G. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel. Length to suit application.

- 1. Minimum Thickness:
 - a. 18GA-0.05 inch, as indicated.
- 2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- H. Mounting Orientation: Vertical or horizontal as indicated.
- I. Blades: Roll-formed, interlocking, galvanized sheet steel.
 - Thickness:
 - a. 24GA-0.024-inch-
 - 2. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
- J. Horizontal Dampers: Include blade lock and Type 301 constant force stainless-steel closure spring.
- K. Heat-Responsive Device: Replaceable, 212 deg F rated, fusible links.
- L. Accessories:
 - 1. Auxiliary switches for signaling:
 - a. Position indication.

2.9 SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Greenheck Fan Corporation.
 - 2. Nailor Industries Inc.
 - Pottorff.
 - 4. Ruskin Company.
 - 5. United Enertech
- B. General Requirements: Label according to UL 555S by an NRTL.
- C. <u>Smoke Detector: See electrical for smoke detector requirements.</u>
- C. Frame: Galvanized sheet steel. With or without mounting flange as required.
 - 1. Thickness:
 - a. Hat-shaped, 16GA-0.064-inch.
 - 2. Corners:
 - a. Welded.
- D. Blades: Horizontal, galvanized sheet steel.
 - 1. Section;
 - a. Roll-formed.
 - 2. Fit:
 - a. Interlocking.
 - 3. Thickness:
 - a. 14GA-0.079-inch.
- E. Leakage:
 - 1. Class II.
- F. Seals:

- 1. Blade: Inflatable silicone fiberglass material to maintain smoke leakage rating to a minimum of 450 deg F.
- G. Rated pressure and velocity to exceed design airflow conditions.
- H. Mounting Sleeve: Factory-installed, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.
 - 1. Minimum 17-inches long.
 - 2. Thickness:
 - a. 0.05-inch-.
- I. Damper Motors: Damper motors to be Belimo or approved equal. Honeywell motors are not allowed.
 - 1. Action:
 - a. Two-position
 - 2. Mode: Fail close.
 - 3. Mounting: External.
- J. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - 1. Electrical Connection: 115 V, single phase, 60 Hz .
- K. Accessories:
 - 1. Auxiliary switches for signaling:
 - a. Position indication.
 - 2. Test Switch type:
 - a. Momentary test switch.
 - 3. Test Switch Mounting:
 - a. Damper.

2.10 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Greenheck Fan Corporation.
 - 2. Nailor Industries Inc.
 - 3. Pottorff.
 - 4. Ruskin Company.
 - 5. United Enertech
- B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum velocity of:
 - 1. 4000-fpm
- D. Fire Rating:
 - 1. 1-1/2 hours.
- E. Frame: Hat shaped, galvanized sheet steel. With or without mounting flange as required.
 - 1. Thickness:
 - a. 16GA-0.064-inch
 - 2. Corners:
 - a. Welded.

- F. Heat-Responsive Device: Replaceable, 212 deg F rated, fusible links.
- G. Blades: Horizontal, galvanized sheet steel.
 - 1. Type:
 - a. Air-foil.
 - 2. Fit:
 - a. Interlocking.
 - Thickness:
 - a. 0.063-inch-.
- H. Leakage:
 - Class I.
- I. Rated pressure and velocity to exceed design airflow conditions.
- J. Mounting Sleeve: Factory-installed, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.
 - 1. Thickness:
 - a. 18GA 0.05-inch-.
- K. Master control panel for use in dynamic smoke-management systems.
- L. Damper Motors: Damper Motors to be Belimo or approved equal. Honeywell motors are not allowed.
 - 1. Locate outside air stream unless otherwise indicated.
 - 2. Action: Two-position.
 - 3. Voltage: to match fire alarm system (coordinate).
 - 4. Listed: UL, as part of damper assembly.
 - 5. Outdoor Motors and Motors in Outside-Air Intakes:
 - a. Gaskets: O-ring gaskets designed to make motors weatherproof.
 - b. Internal Heaters: Equip to permit normal operation at minus 40 deg F.
- M. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "common Motor Requirements for HVAC Equipment."
 - 1. Electrical Connection: 115 V, single phase, 60 Hz.
- N. Monitoring: All combination fire & smoke dampers are to have the following parameters monitored as part of the fire alarm system:
 - 1. Damper status.
 - 2. Damper Position.
- O. Accessories:
 - 1. Auxiliary switches:
 - a. Signaling.
 - b. Position Indication.
 - 2. Test Switch Type:
 - a. Momentary test switch.
 - 3. Test Switch Mounting:
 - a. Damper.

2.11 DUCT SILENCERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Industrial Acoustics Company.

- 2. Ruskin Company.
- 3. SEMCO Incorporated.
- 4. Vibro-Acoustics.

B. General Requirements:

- 1. Factory fabricated.
- 2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.
- 3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Shape:

- 1. Rectangular straight with splitters or baffles.
- 2. Round straight with center bodies or pods.
- 3. Rectangular elbow with splitters or baffles.
- 4. Round elbow with center bodies or pods.
- 5. Rectangular transitional with splitters or baffles.
- D. Rectangular Silencer Outer Casing: Galvanized sheet steel.
 - 1. ASTM A 653:
 - a. G60.
 - 2. Thickness:
 - a. 22GA-0.034 inch.
- E. Round Silencer Outer Casing: Galvanized sheet steel.
 - 1. ASTM A 653:
 - a. G60.
 - 2. Sheet Metal Thickness for Units up to 24 Inches in Diameter: 22GA-0.034 inch thick.
 - 3. Sheet Metal Thickness for Units 26 through 40 Inches in Diameter: 20GA-0.040 inch
 - 4. Sheet Metal Thickness for Units 42 through 52 Inches in Diameter: 18GA-0.05 inch thick.
 - 5. Sheet Metal Thickness for Units 54 through 60 Inches in Diameter: 16GA-0.064 inch thick.
- F. Inner Casing and Baffles: Galvanized sheet metal with 1/8-inch- diameter perforations.
 - 1. ASTM A 653:
 - a. G60.
 - 2. Thickness:
 - a. 22GA-0.034 inch.
- G. Special Construction:
 - 1. Suitable for outdoor use.
 - 2. High transmission loss to achieve STC 45.
- H. Connection Sizes: Match connecting ductwork unless otherwise indicated.
- I. Principal Sound-Absorbing Mechanism:
 - 1. Controlled impedance membranes and broadly tuned resonators without absorptive media.
 - 2. Dissipative or Film-lined type with fill material:

- a. Fill Material: Inert and vermin-proof fibrous material, packed under not less than 15 percent compression
- b. Erosion Barrier: Polymer bag enclosing fill, and heat sealed before assembly.
- c. Prohibited: Mineral wool will not be permitted as a substitute for glass fiber.
- 3. Lining:
 - a. Material:
 - 1) Tedlar
 - b. Prohibited: Mesh, screen or corrugated perforated liner will not be acceptable as a substitute for the specified spacer.
- J. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.
 - 1. Joints:
 - a. Lock formed and sealed.
 - 2. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
 - 3. Reinforcement: Cross or trapeze angles for rigid suspension.
 - 4. Structural Criteria: The silencers shall not fail structurally when subjected to a differential air pressure of 8 inches water gage.
 - 5. Spot Welds: All spot welds shall be painted.

K. Accessories:

- 1. Integral 1-1/2-hour fire damper with access door. Access door to be high transmission loss to match silencer.
- 2. Factory-installed end caps to prevent contamination during shipping.
- 3. Removable splitters.
- 4. Airflow measuring devices.

2.12 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. METALAIRE, Inc.
 - 2. SEMCO Incorporated.
 - 3. 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. Fabricate single blade vanes to comply with SMACNA's "HVAC Duct Construction Standards-Metal and Flexible."
 - 2. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- D. 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."
- E. Vane Construction:

- Single wall
- F. Vane Spacing:
 - 1. 1-1/2" spacing between turning vanes
 - 2. 3-1/4" spacing not allowed.
- G. Vane Construction: Single wall for ducts up to 36 inches wide and additional bracing for larger dimensions.

2.13 REMOTE DAMPER OPERATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - Pottorff.
 - 2. Ruskin Company; Tomkins PLC.
- B. Cable Type:
 - 1. Description: Cable system designed for remote manual damper adjustment.
 - 2. Tubing/Sheathing: Galvinsed, Brass, Copper or Aluminum.
 - 3. Cable: Stainless steel or Steel.
 - 4. Wall-Box Mounting: Coordinate with Architect.
 - 5. Wall-Box Cover-Plate Material: Coordinate with Architect.
- C. Activated Electric Type:
 - 1. Description: Electrically activated zone control damper for remote adjustment. When an adjustment is needed the system is powered up.
 - 2. Means: Factory mounted actuator factory wired to damper.
 - 3. Portable 9 volt system. No field power requirement.
 - 4. Mounting: Recessed Wall Box or Diffuser or Hand Held.
 - 5. Wall-Box Cover Finish: Coordinate with Architect.
 - 6. Wall-Box Porting: 1 to 6 ports or more.

2.14 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Greenheck Fan Corporation.
 - 2. McGill AirFlow LLC.
 - Pottorff.
 - 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
 - 5. Ruskin Company
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors Round Duct."
 - 1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - d. Fabricate doors airtight and suitable for duct pressure class.

- 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
- 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square:
 - 1) Hinges:
 - a) Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches, provide outside and inside handles:
 - 1) Hinges:
 - Three hinges and two compression latches.
 - d. Access Doors Larger Than 24 by 48 Inches, provide outside and inside handles:
 - 1) Hinges:
 - Continuous and two compression latches with outside and inside handles.

2.15 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Ventfabrics, Inc.
 - 3. 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 wide fabric strip attached to two narrower metal strips. Provide strips of metal compatible with connected ducts.
 - 1. Wide Strip:
 - a. 3-1/2 inches.
 - 2. Narrow Strips:
 - a. 0.028-inch- thick, galvanized sheet steel.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd..
 - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F.
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - 1. Minimum Weight: 24 oz./sq. yd..
 - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
 - 3. Service Temperature: Minus 50 to plus 250 deg F.

2.16 DUCT SECURITY BARS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carnes.
 - 2. KEES, Inc.
 - 3. Lloyd Industries, Inc.

- 4. Metal Form Manufacturing, Inc.
- Price Industries.
- 6. Titus
- 7. Krueger
- B. Description: Factory-fabricated and field-installed duct security bars.
- C. Configuration:
 - 1. Frame: 1-1/2 by 1-1/2 by 3/16 inch angle.
 - 2. Sleeve: 3/16-inch, continuously welded steel frames with 1-1/2-by-1-1/2-by-1/8- angle frame furnished loose for field welding on other end. To be poured in place or set with concrete block or welded or bolted to wall, one side only. Duct connections on both sides.
 - 3. Horizontal Bars: 3/4 inch steel.
 - 4. Vertical Bars: 3/4 inch steel
 - 5. Bar Spacing: 6 inches.
 - 6. Mounting: Ductwork or other framing.
- D. Finish:
 - 1. White

2.17 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.
 - Themaflex
 - 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Ducts shall conform to the requirements for Class I connectors when tested in accordance with "Standard for Factory Made Air Ducts Materials and Air Duct Connectors" (UL 181).
- C. Ducts shall also pass the 15 minute U.L. flame penetration test as specified in the UL 181 Standard.
- D. Insulated, Flexible Duct: Two-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor-barrier film.
 - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 - 2. Maximum Air Velocity: 4000 fpm.
 - 3. Temperature Range: Minus 10 to plus 160 deg F.
 - 4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.
- E. Flexible Duct Connectors:
 - 1. Clamps: in sizes 3 through 18 inches, to suit duct size.
 - a. Material: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action.
 - b. Clamps must be approved and listed with a UL181B-C listing.
 - 2. Nylon Duct Cable Tie: In sizes 3 through 18 inches, to suit duct size.
 - a. Material: Nylon
 - Fastener must be approved and listed with a UL181B-C listing.
 - 3. Adhesive Tape:

- a. Material: Metalized polypropylene.
- b. Tape must be approved and listed with a UL181B-FX listing.

2.18 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.
- C. Splitter Damper Accessories: Zinc-plated damper blade bracket; 1/4-inch, zinc-plated operating rod; and a duct-mounted, ball-joint bracket with flat rubber gasket and square-head set screw.
- D. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 to 18 inches to suit duct size.

2.19 HIGH EFFICIENCY TAKE-OFFS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
 - 1. Air-Rite
 - 2. Hercules Industries
 - Sheet Metal Connectors, Inc.
 - Spiral Manufacturing Co. Inc.
 - 5. Ferguson
- B. Materials:
 - 1. 24 gauge galvanized sheet metal meeting ASTM A653 and A924
- C. Take-off shall meet SMACNA third edition Section 4.8 figure 4.6 45 degree entry.
- D. Rectangular opening with flanged sides on all sides. Complete with closed cell neoprene gasket to provide a tight seal.
- E. Zeros VOC's

PART 3 - EXECUTION

3.1 INSTALLATION

General

- 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. Use the Remote Damper Operator when they are called out on the drawings or when the damper cannot be easily accessed.
- D. Install duct security bars. Construct duct security bars from 3/16-inch steel sleeve, continuously welded at all joints and 3/4-inch- diameter steel bars, 6 inches o.c. in each direction in center of sleeve. Weld each bar to steel sleeve and each crossing bar. Weld 1-1/2-by-1-1/2-by-1/8- steel angle to 4 sides and both ends of sleeve. Connect duct security bars to ducts with flexible connections. Provide 12-by-12-inch hinged access panel with cam lock in duct in each side of sleeve.
- E. Install high efficiency take-off on all branch duct take-offs. Provide take-off with balancing damper as shown on drawings. Spin-in fittings are not allowed.

Flexible Ducts / Flexible Duct Connectors

- F. Install flexible connectors to connect ducts to equipment.
- G. Flexible duct connections from the main trunk ducts to diffuser boots shall be furnished and installed as shown on the drawings. Flexible ductwork shall only be used as indicated on the drawings.
- H. Where flexible duct is indicated, use insulated flexible duct for supply air return and exhaust air.
- I. Flexible ductwork shall be run in straight lengths.
- J. Provide support in flexible duct every three feet.
- K. Flexible ducts shall have compression fittings on both ends.
- L. Flexible ductwork is not allowed to bend 90 degrees. If a bend is needed use sheet-metal hard elbows. Hard turns, offsets, or kinks will not be allowed.
- M. Flexible ducts shall connect to trunk duct with high efficiency takeoffs.
- N. Connect flexible ducts to metal ducts with draw bands.
- O. Connect ducts to duct silencers:
 - With flexible duct connectors.
- P. Connect terminal units to supply ducts:
 - 1. With maximum 12-inch lengths of flexible duct.
- Q. Do not use flexible ducts to change directions.
- R. Connect diffusers or light troffer boots to ducts:
 - 1. With maximum 60-inch lengths of flexible duct clamped or strapped in place.

Backdraft/Control/Pressure Relief Dampers

- S. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- T. Install pressure relief damper immediately upstream of main fire damper.

Volume Damper

U. 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.
- 2. Install aluminum volume dampers in aluminum ducts.
- V. Set dampers to fully open position before testing, adjusting, and balancing. Exception: Pressure relief damper.
- W. A balance damper with locking quadrant will be provided downstream of take-off from trunk duct.

Fans And Test Holes

- X. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- Y. 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 movement during start and stop of fans.
- Z. Install duct test holes where required for testing and balancing purposes.
- AA. Install test holes at fan inlets and outlets and elsewhere as indicated.

FIRE, SMOKE AND FIRE-SMOKE DAMPERS

- BB. Install fire and smoke dampers according to UL listing.
 - Install fusible links in fire dampers.
- CC. For round ductwork 24-inch and smaller a true round fire damper with the same rating may be used.

Access Doors

- DD. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On upstream side of duct coils.
 - 2. Upstream from duct filters.
 - 3. At outdoor-air intakes and mixed-air plenums.
 - 4. At drain pans and seals.
 - 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 - 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be standard access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 7. At each change in direction and at maximum 50-foot spacing.
 - 8. Upstream from turning vanes.
 - 9. Upstream or downstream from duct silencers.
 - 10. Control devices requiring inspection.
 - 11. Elsewhere as indicated.
 - 12. On upstream side of duct reheat coils. (between Phoenix valve and reheat coil)
- EE. Install access doors with swing against duct static pressure.

FF. Access Door Sizes:

- 1. One-Hand or Inspection Access: 8 by 5 inches.
- 2. Two-Hand Access: 12 by 6 inches.
- 3. Head and Hand Access: 18 by 10 inches.
- 4. Head and Shoulders Access: 21 by 14 inches.
- 5. Body Access: 25 by 14 inches.
- 6. Body plus Ladder Access: 25 by 17 inches.
- GG. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

- 1. Operate dampers to verify full range of movement.
- Inspect locations of access doors and verify that purpose of access door can be performed.
- 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
- 4. Inspect turning vanes for proper and secure installation.
- 5. Operate remote damper operators to verify full range of movement of operator and damper.

3.3 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Adjust fire and smoke dampers for proper action.
- C. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

END OF SECTION

SECTION 23 3600

AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Shutoff, single-duct air terminal units.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following products, including rated capacities, furnished specialties, sound-power ratings, and accessories.
 - 1. Air terminal units.
 - 2. Liners and adhesives.
 - Sealants and gaskets.
 - 4. Seismic-restraint devices.

B. LEED Submittals:

- 1. Product Data for Prerequisite IEQ 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.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams:
 - For power, signal, and control wiring.
 - b. Differentiate between manufacturer-installed and field-installed wiring.
 - 3. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

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.
- E. Airborne noise data for terminal units serving Patient Rooms:

- 1. Declared discharge and radiated sound power levels by octave band covering a minimum range of 63 to 4000 hertz
- 2. Method of determining declared sound power levels.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Size and location of initial access modules for acoustic tile.
 - 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- B. Field quality-control reports.

1.5 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Air terminal units shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Instructions for resetting minimum and maximum air volumes.
 - 2. Instructions for adjusting software set points.

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. Fan-Powered-Unit Filters: Furnish one spare filter for each filter installed.

1.8 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. Product Options: Drawings and schedules indicate requirements of air terminals and are based on specific systems indicated. Other manufacturers' systems with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."
- C. Listing and Labeling: Provide electrically operated air terminals specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.

- D. NFPA Compliance: Install air terminals according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- E. Comply with NFPA 70 for electrical components and installation.
- F. Airborne Noise:
 - 1. Comply with ANSI / AHRI 880 Performance Rating of Air Terminals

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards Metal and Flexible".
- B. Airborne Noise:
 - 1. Maximum sound power levels by octave band in decibels referenced to on picowatt:

A LILL	Source	Sound Power Level by Octave Band (Hz), dBL (re 10 -12 W)						
AHU		63	125	250	500	1000	2000	4000
VAV Box serving Patient Rooms	Discharge	71	69	69	62	54	50	47
	Radiated	60	60	58	50	40	36	33

2.2 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.

2.3 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Anemostat Products; a Mestek Company.
 - 2. Carnes.
 - 3. Environmental Technologies, Inc.
 - 4. Krueger.
 - 5. METALAIRE, Inc.
 - 6. Nailor Industries Inc.
 - 7. Price Industries.
 - 8. Titus.
 - 9. Trox USA Inc.; a subsidiary of the TROX GROUP.
 - 10. Tuttle & Bailey.
 - 11. Warren Technology.
- B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.

- C. Casing: 0.034-inch steel, single wall.
 - 1. Casing Lining: Adhesive attached, 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. Lining thickness:
 - 1) 1/2-inch-
 - b. Cover liner with nonporous foil.
 - 2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
 - 3. Air Outlet: S-slip and drive connections.
 - 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. (LEED) Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
 - 7. Access Door: Access door upstream of the reheat coil.
- D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
 - 1. Maximum Damper Leakage:
 - a. ARI 880 rated, 3 percent of nominal airflow at 3-inch wg inlet static pressure.
 - 2. Damper Position:
 - a. Normally open.
- E. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.
- F. Direct Digital Controls: See Section 230900 "Instrumentation and Controls for HVAC".

2.4 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.

2.5 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, 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.
- D. Install discharge air temperature sensors at the outlet of each Air Terminal Unit.
- E. Connect ductwork to air terminals according to Division 23 ductwork Sections.
- F. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices in Section 230548 "Vibration and Seismic Controls for HVAC."
- G. For Diffuser Type Air Terminal Units, provide and install all necessary control wiring and control voltage transformer. See drawings AND schedules for additional information.

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 thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches 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 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," 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 Section 233113 "Metal Ducts.

- D. Make connections to air terminal units with flexible connectors complying with requirements in Section 233300 "Air Duct Accessories."
- E. Electrically ground all equipment:
 - Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 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.

3.5 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. 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.
- D. Air terminal unit will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.
- F. Cleaning:
 - 1. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to:
 - a. Manufacturer's written instructions.
 - b. Construction documents.
 - 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.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air terminal units:
 - 1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
 - 2. Review data in the maintenance manuals. Refer to Division 1 Section "Contract Closeout."
 - 3. Review data in the maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
 - 4. Schedule training with Owner, through Architect, with at least 7 days' advance notice.

END OF SECTION

SECTION 23 3713

DIFFUSERS, REGISTERS, AND GRILLES

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 ceiling- and wall-mounted diffusers, registers, and grilles.
- B. Related Sections:
 - 1. Section 233714 "Fixed Louvers" for fixed and 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.
 - 3. Section 230594 "General Testing, Adjusting and Balancing" for balancing diffusers, registers, and grilles.

1.3 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.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Method of attaching hangers to building structure.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 - 5. Duct access panels.
- B. Source quality-control reports.

1.5 QUALITY ASSURANCE

A. Product Options: Drawings and schedules indicate specific requirements of diffusers, registers, and grilles and are based on the specific requirements of the systems indicated.

- B. NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems."
- C. Airborne Noise:
 - 1. Comply with ANSI / AHRI 880 Performance Rating of Air Terminals

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - Air Factors
 - 2. Carnes.
 - 3. Kruegar.
 - 4. METALAIRE, Inc.
 - 5. Nailor Industries Inc.
 - 6. Price Industries.
 - 7. Titus.
 - 8. Tuttle & Bailey.
 - 9. AJ Manufacturing

2.2 REGISTERS, GRILLES, & DIFFUSERS

A. General: The frames for all registers, grilles, and diffusers shall match type of ceiling where they are to be installed. Special frames shall be provided for narrow T-bar ceilings. Refer to reflected ceiling plan and other specification divisions for ceiling type. See drawings AND schedules for additional information.

2.3 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 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions, coordination drawings, original design, and referenced standards.

- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as 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.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.4 CLEANING

A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION

SECTION 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)

a.

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 (non exclusive):
 - 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"
 - Section 27 00 00 "Intermountain Healthcare Networked Structured Cable & Standards" for cabling used for voice and data circuits.
 - 6. Section 27 41 33 "Master Antenna Television System"
 - 7. Section 27 51 17 "Networked Public Address and Paging System"
 - 8. Section 28 13 00 "Access Control"
 - 9. Section 28 31 11 "Digital, Addressable Fire-Alarm System"
- C. The mechanical controls contractor and other vendors installing low voltage power communications cabling for related non-electrical systems shall comply with this and related sections insofar as support of cabling, etc.

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 208Y/120 volt systems and Grey 480Y/277 volt systems.
 - 6. Maximum Voltage Rating: 600 volts.
 - 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:
 - 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.

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 or stranded for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- 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.
 - 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.
 - 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.
 - 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.

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" and Division 27 00 00 and related sections "Intermountain Structured Cable Specifications."
- G. Support all cables per project specifications; do not support cables using other conduits, devices, ducts, equipment, etc., or by draping cabling across project components.
- H. Install non-data and telecommunications cabling installed under this section in j-hooks adjacent to cable trays. Do not install non-data and telecommunications cabling in cable trays.

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.

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 00 "Firestopping."

3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 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.
 - 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.
 - 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:
 - 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.
 - 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.
- 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 travs 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).
- 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.
- C. Installation and bonding of grounding electrodes including bonding of the metal frame of the structure, concrete-encased electrodes including UFER grounds, ground ring and rod electrodes is provided under previous bid package 3.01.

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:
 - 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.
- 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.
 - 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.
 - 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:
 - 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:
 - Hangers.
 - b. Steel slotted support systems.
 - c. Nonmetallic support systems.
 - d. Trapeze hangers.
 - e. Clamps.
 - f. Turnbuckles.
 - g. Sockets.
 - h. Eve 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.
 - Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-
 - 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 Jhooks. Where cables extend from Jhooks 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.
- 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."

- Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.
- D. Samples: For receptacle raceways and for each color and texture specified, 12 inches (300 mm) long.

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.
 - Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
 - 2. Fittings for EMT:
 - Material: Steel.
 - b. Type: 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.
- 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 multigang 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. <u>Manufacturers:</u> 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.
 - 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 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 fireresistance-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:
 - 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.
 - 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 boottype 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 48

SEISMIC CONTROLS 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:
 - Restraint channel bracings.
 - 2. Restraint cables.
 - 3. Seismic-restraint accessories.
 - 4. Mechanical anchor bolts.
 - 5. Adhesive anchor bolts.

B. Related Requirements:

1. Section 26 05 29 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
- B. Delegated-Design Submittal: For each seismic-restraint device.
 - 1. Include design calculations and details for selecting seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional or structural engineer responsible for their preparation.
 - 2. Design Calculations: Calculate static and dynamic loading caused by equipment weight, operation, and seismic forces required to select seismic restraints and for designing vibration isolation bases.
 - Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
 - 3. Seismic-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and

- values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
- c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
- d. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.
- B. Qualification Data: For professional or structural engineer.
- C. Welding certificates.
- D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Observation Report signed by the professional or structural engineer responsible for the design calculations and details for the seismic restraint devices indicating that all restraints have been installed and tested per the approved action submittal documents.

1.6 QUALITY ASSURANCE

- 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. They shall bear anchorage preapproval, showing maximum seismic-restraint ratings, by ICC-ES or another agency acceptable to authorities having jurisdiction. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) that support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
- D. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading: Refer to Structural criteria for the project.

2.2 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, with other matching components, and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.3 RESTRAINT CABLES

A. Restraint Cables: ASTM A 492 stainless-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.

2.4 SEISMIC-RESTRAINT ACCESSORIES

- A. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- 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.

2.5 MECHANICAL ANCHOR BOLTS

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

2.6 ADHESIVE ANCHOR BOLTS

A. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables 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 caused by seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 03 30 00 "Cast-in-Place Concrete" and Section 03 30 53 "Miscellaneous Cast-in-Place Concrete."
- B. Equipment and Hanger Restraints:
 - 1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
 - 2. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. 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.
- E. 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.

F. Drilled-in Anchors:

 Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

- Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
- 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
- 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
- 5. Set anchors to manufacturer's recommended torque using a torque wrench.
- 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

- A. Perform the following 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 postconnection 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.
- B. Seismic controls will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust restraints to permit free movement of equipment within normal mode of operation.

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 that is 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): White letters on gray 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. Raceways:
 - 1. Labeling: Black on orange. Include system voltage and type.
 - 2. Color Coding for Raceways:
 - a. Fire Alarm: Red (BA2)

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.

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 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.
- I. 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 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 containing the wiring system legend and system voltage. System legends shall be as follows:
 - 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. 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
- F. 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.
 - 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. Install instructional sign, including the color code for grounded and ungrounded conductors using adhesive-film-type labels.
- H. 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. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive vinyl labels with the conductor designation.
- J. Conductors To Be Extended in the Future: Attach write-on tags to conductors and list source.
- K. 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. 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. 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. 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. 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. 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. 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. 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, 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 fro project conditions and coverage patterns for submitted devices.
 - 2. Interconnection diagrams showing field-installed wiring.
 - 3. Include diagrams for power, signal, and control wiring.

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. <u>TE Connectivity Ltd.</u>
- 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. <u>Lutron, Inc.</u>
 - 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. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
 - 1. <u>Eaton (Cooper Controls), Inc.</u>
 - 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.
 - 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. <u>ASCO Power Technologies, LP; a division of Emerson Electric Co.</u>
 - 3. <u>Eaton Corporation</u>.
 - 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. <u>Manufacturers:</u> Subject to compliance with requirements, provide products by one of the following:
 - 1. <u>Eaton (Cooper Controls), Inc.</u>
 - 2. Lutron, Inc.
 - 3. <u>Leviton Manufacturing Co., Inc.</u>
 - 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 structureborne 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

RESPONSIBILITY MATRIX

Updated January 5, 2021

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.

OFOI - (Owner Furnished / Owner Installed)							
		nd track within construction schedule)					
<u>ITEM</u>	OWNER/VENDOR	<u>NOTES</u>	Data	Power	Backing		
Art	Owner / Owner (Alpine Art)	All artwork to be coordinated with Dan Kohler. Provide power to required artwork.					
Brochure Racks	Owner / Owner	Contractor to provide proper backing.					
Chart Racks	Owner / Owner (Midwest)	Contractor to provide proper backing.					
Copiers, fax	Owner / Owner	A/E to locate where copy/fax/printer is not visual clutter.	Yes	Yes			
Cup Dispensers	Owner / Owner						
Exam Tables	Owner / 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			
Receptionist Desk	Owner / Owner (Midwest & Steelcase)						
Moveable Metal Shelving	Owner / Owner						
Recliners / Draw Chairs	Owner / Owner						
Signage - Exterior	Owner / Owner (IG Group, 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 (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.					
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			
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		
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		

Keyboard Trays	Owner / Owner				
PACS	Owner / Owner				
Magnetic Marker Boards, Cork Boards, Huddle Boards, Idea Tracking Boards, etc.	Owner / Owner (Midwest)	A/E to coordinate location with Owner.			Yes
Emergency Evacuation Medical Sled (Med Sled)	Owner / Owner	A/E to coordinate location with Owner.			
Supply Area Panels	Owner / Owner	Contractor to provide proper backing, coordinate with Owner.			Yes
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	
Nurse Notification Call (NNC) System & Devices (Hospital Campus)	Owner / Owner (Hill-Rom)	Hospital local facility team to work with Supply Chain Facility Equipment Planning team to contract directly with Nurse Notification Call (NNC) system vendor (Hill-Rom) 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 Hill-Rom on their site-specific drawings. Hill-Rom site specific drawings to be coordinated and included in the A/E Contract Documents. Contractor to provide all infrastructure including conduits, back boxes, cabling (e.g. homeruns 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 Hill-Rom.	Yes; see CFCI	Yes; see CFCI	
Staff Assist Notification Call System & Devices (Medical Group Clinics on hospital campuses to match NNC system)	Owner / Owner (Hill-Rom)	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 (Hill-Rom) 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 Hill-Rom for all Staff Assist Notification Call system infrastructure required to support the device locations and types designated by Hill-Rom on their site-specific drawings. Hill-Rom site specific drawings to be coordinated 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 Hill-Rom.	Yes; see CFCI	Yes; see CFCI	

Staff Assist Notification Call System & Devices (Stand-alone Medical Group Clinics)	Owner / Owner (Hill-Rom)	IMG Ops team to work with Supply Chain Facility Equipment Planning team to contract directly with Staff Assist Notification Call system vendor (Hill-Rom) 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 Hill-Rom for all Staff Assist Notification Call system infrastructure required to support the device locations and types designated by Hill-Rom on their site-specific drawings. Hill-Rom site specific drawings to be coordinated 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, GSR10, 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 Hill-Rom.	Yes; see CFCI	Yes; see CFCI	
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	
IV Hangar	Owner / Owner	A/E to identify locations on drawings, coordinate with Owner. Backing to be coordinated, if required.			
Sharps Disposal Container	Owner / Owner (Stericycle)	A/E to identify locations on drawings, coordinate with Owner. Backing to be coordinated, if required.			
Infant/Pediatric Security System	Owner / Owner (Totguard)	A/E to identify locations on drawings. This system is to be coordinated with Owner, Women's and Children's Operations, Clinical Programs and Security.	Yes	Yes	

Coordinate location of items with Owner and track within construction schedule)

<u>ITEM</u>	OWNER/VENDOR	NOTES	Data	Power	Backing
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
Time Clocks	Owner / Contractor	Conduit and boxes by Contractor, Coordinate location with Owner.	Yes	Yes	
Paper Towel Dispensers	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.			
Soap Dispensers	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.			
Toilet Paper Dispensers	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.			
Sanitary Napkin Dispensers/Receptacles	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.			
Diaper Changing Station	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.			Yes
Hand Sanitizer Dispensers (Avagard)	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.			

Diagnostic Dear-					
Diagnostic Board (Otoscope / Ophthalmoscope)	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.		Yes	
Stadiometers, Recessed Scales	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner; coordinate power.		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
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
IV Track	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner. Backing to be coordinated, if required.			Yes
Boom Mounting Plates (Equipment, Lighting, Anesthesia)	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
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
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
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.			
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.			
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
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
Patient Lifts		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	
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	
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
iCentra Tracking Boards	Owner / Contractor	A/E to identify locations on drawings, coordinate with Owner.	Yes	Yes	Yes

Distributed Antenna System (DAS) including Public Safety	by Intermountain	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.			
Alertus - Mass Notification System (Public Areas)	Owner (Alertus) / Contractor	A/E to identify locations on drawings, coordinate with Owner.	Yes	Yes	

CFCI - (Contractor Furnished / Contractor Installed)

CFCI - (Contractor Fur	ilisileu / Colitiactor i	nstaneu)			
<u>ITEM</u>	OWNER/VENDOR	NOTES	Data	Power	Backing
Communication Boards (e.g. Patient Rooms)	Contractor / Contractor	A/E to identify locations on drawings, coordinate with Owner.			Yes
Emergency Phones, Kiosks - Exterior	Contractor / Contractor	A/E to identify locations on drawings, coordinate with Owner. Conduit and boxes by Contractor.	Yes	Yes	Yes
Med Gas Certification	Contractor / Contractor	Contractor to coordinate Vendor with Owner			
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.			
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
Coat Hooks (Rest rooms/Showers, Exam rooms, Offices/Workstations only)		A/E to identify locations on drawings.			
Mirrors (Rest rooms, Exams, Radiology, Rehab, etc.)	Contractor / Contractor	A/E to identify locations on drawings, coordinate with Owner.			Yes
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	
Plumbing Shrouds	Contractor / Contractor				
	Contractor / Contractor (AlphaCorp/Convergint)	A/E to identify locations on drawings, coordinate with Owner.	Yes		
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		
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
Wall Protection (Incl. Bumper and Corner Guards)	Contractor / Contractor	A/E to identify locations on drawings, coordinate with Owner.			
Intrusion Detection	Contractor / Contractor	A/E to identify locations on drawings, coordinate with Owner.			

Access Control, Card Readers (Lenel)	Contractor / Contractor (AlphaCorp/Convergint)	A/E to identify locations on drawings, coordinate with Owner.			
Communication Cabling	,	A/E to identify locations on drawings, coordinate with Owner.			
TV System Distribution	Contractor / Contractor	A/E to identify locations on drawings, coordinate with Owner.			
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	
Nurse Notification Call (NNC) System - Low Voltage Cabling (Hospital Campus)	Contractor / Contractor (Hill-Rom)	A/E to coordinate with Owner and Hill-Rom for all NNC infrastructure required to support the device locations and types designated by Hill-Rom on their site-specific drawings. Hill-Rom site specific drawings to be coordinated 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 Hill-Rom.	Yes	Yes	
Staff Assist Notification Call System - Low Voltage Cabling (Medical Group Clinics on hospital campuses to match NNC system)	Contractor / Contractor (Hill-Rom)	A/E to coordinate with Owner and Hill-Rom for all Staff Assist Notification Call system infrastructure required to support the device locations and types designated by Hill-Rom on their site-specific drawings. Hill-Rom site specific drawings to be coordinated 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 Hill-Rom.	Yes	Yes	
Staff Assist Notification Call System - Low Voltage Cabling (Stand- alone Medical Group Clinics)	Contractor / Contractor (Hill-Rom)	A/E to coordinate with Owner and Hill-Rom for all Staff Assist Notification Call system infrastructure required to support the device locations and types designated by Hill-Rom on their site-specific drawings. Hill-Rom site specific drawings to be coordinated 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, GSR10, 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 Hill-Rom.	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	

END OF SECTION