



**CITY OF CHANDLER
JOB ORDER PROJECT AGREEMENT**

POLICE WORK AREA AND STORAGE RENOVATION

PROJECT NO. PD2205.401

This JOB ORDER PROJECT AGREEMENT ("Job Order") is made this _____ day of _____ 2023 ("Effective Date"), by and between the City of Chandler, an Arizona municipal corporation, ("City") and **SDB, Inc.**, an Arizona corporation, ("JOC Contractor") and is entered into pursuant to Job Order Master Agreement No. JOC1912.401 ("JOC Master Agreement"). City and JOC Contractor may be referred to individually as "Party" or collectively as "Parties").

City and JOC Contractor, in consideration of the mutual covenants herein set forth, agree as follows:

RECITALS

A. On or about January 28, 2020, the Parties entered into the JOC Master Agreement, which terms and conditions are made a part of and incorporated into this Job Order Project Agreement by this reference.

B. City proposes to engage JOC Contractor to provide police work area and storage renovations as more fully described in **Exhibit "A"** and **Exhibit "A-1"**, which is attached to and made a part of this Job Order by this reference.

C. JOC Contractor is ready, willing, and able to provide the services described in **Exhibit "A"** for the compensation and fees set forth and as described in **Exhibit "B"**, which is attached to and made a part of this Agreement by this reference.

ARTICLE 1. DESCRIPTION OF WORK

The Parties enter into this Job Order Project Agreement for the **POLICE WORK AREA AND STORAGE RENOVATION**, Project Number **PD2205.401**. The scope of work consists of police work area and storage renovations, all as more particularly set forth in **Exhibit "A"** attached hereto and incorporated herein by reference.

The JOC Contractor will not accept any change of scope, or change in contract provisions, unless issued in writing, as a contract amendment or change order and signed by the authorized signatories for each party.

Performance and Payment Bonds, as set forth in **Exhibit "C"** and **Exhibit "D"** respectively attached hereto and incorporated herein by reference, will be due prior to execution of each Job Order Project Agreement in the full amount of each Job Order.

At project completion, JOC Contractor must complete Contractor's Affidavit Regarding Settlement of Claims and Certificate of Completion, as set forth in **Exhibit "E"** and **Exhibit "F"** respectively attached hereto and incorporated herein by reference.

ARTICLE 2. PROJECT PRICE

City will pay JOC Contractor for completion of the Work in accordance with the JOC Master Agreement a fee not to exceed the Guaranteed Maximum Price of **\$1,808,582.79** Dollars determined and payable as set forth in JOC Master Agreement and **Exhibit "B"** attached hereto and made a part hereof by reference.

ARTICLE 3. CONTRACT TIME & SCHEDULE

JOC Contractor agrees to complete all Construction within **173** calendar days from the Notice to Proceed (NTP) Date.

ARTICLE 4. PARTICIPANTS

CITY:	Construction Project Manager: Jason Garcia	
	Phone:	480-782-3453
	Email:	Jason.garcia@chandleraz.gov
JOC CONTRACTOR:	SDB, Inc.	
	1001 S. Edward Dr. Tempe, AZ 85281	
	JOC Contractor Representative: Craig Schmidt	
	Phone:	480-967-5810 x243
	Email:	Craig.schmidt@sdb.com

ARTICLE 5. FORCED LABOR OF ETHNIC UYGHURS PROHIBITED By entering into this Agreement, Contractor certifies and agrees Contractor does not currently use and will not use for the term of this Agreement: (i) the forced labor of ethnic Uyghurs in the People's Republic of China; or (ii) any goods or services produced by the forced labor of ethnic Uyghurs in the People's Republic of China; or (iii) any contractors, subcontractors or suppliers that use the forced labor or any goods or services produced by the forced labor of ethnic Uyghurs in the People's Republic of China.

SIGNATURE PAGE TO FOLLOW

IN WITNESS WHEREOF, the Parties have executed this Job Order as of the Effective Date.

"CITY"

CITY OF CHANDLER:

MAYOR Date

Recommended By:


Kimberly Moon, P.E.
CIP City Engineer

APPROVED AS TO FORM:

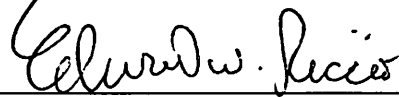
City Attorney By: 

ATTEST:

City Clerk SEAL

"JOC CONTRACTOR"

SDB, Inc.:


Signature Date
Edward W. Riccio
Print Name
CFO
Title

ATTEST: If Corporation

Secretary

ADDRESS FOR NOTICE

SDB, Inc.
1001 S. Edward Dr.
Tempe, AZ 85281

EXHIBIT A SCOPE OF WORK

This project is for the renovation of the existing firing range and shoot house to be repurposed for new office spaces and garage at the Main Police Department building in Chandler. The renovation is to include demo of the existing interior as required, demo of the existing mechanical units, demo of the existing bullet trap, new offices, conference room, interior walls, ceilings, renovated breakroom, renovated restroom, added restrooms, garage, associated electrical and mechanical, data rough ins, rooftop mechanical units to service the new space and the IT room, related electrical and mechanical improvements to the IT room, traffic coating on top of the renovated space and other associated improvements.

Special Provisions: See attached Exhibit A-1 "Project Manual"



12/21/2022

**COC Police Work Area and Storage Renovation
250 ED Chicago St
Chandler, AZ 85225
Attn: Ivan Magana**

RE: Request for Cost Proposal, Job Order Contract No. PD2205.401

Dear Ivan:

Per your request, SDB is pleased to present our proposal for providing all labor, materials, equipment and supervision necessary convert current firing range into offices and working spaces per drawings stamped on 9/20/2022 and 9/30/2022.

Our cost for this scope of work will be:

**One Million Six Hundred Forty Three Thousand One Hundred Seventy Five Dollars and 55/100
(\$1,643,175.55)**

The total cost including owner allowance will be:

**One Million Eight Hundred Eight Thousand Five Hundred Eighty Two Dollars
and 79/100
(\$1,808,582.79)**

Additional inclusions consist of: all applicable sales taxes, performance and payment bonds.

We look forward to working with you and are prepared to proceed with this project immediately.

Thank you for the opportunity.

Sincerely,

A blue ink handwritten signature, appearing to read "Derek Contizano", with a long horizontal flourish extending to the right.

SDB, Inc.
Derek Contizano
Project Executive

1001 S. Edward Drive
Tempe, AZ 85281
480-967-5810 Tel
480-967-5841 Fax



SDB, Inc.
1001 S Edward Drive
Tempe, AZ 85281
(480) 967-5810 Fax (480) 967-5841

JOC PROPOSAL

CUSTOMER:	<u>City of Chandler</u>	BID DATE:	<u>12/22/2022</u>
ADDRESS:	<u>250 E Chicago Street</u>	PROPOSAL NO.:	<u>22-14-0007</u>
	<u>Chandler AZ 85225</u>	PROPOSAL TYPE.:	<u>Lump Sum</u>
JOB DESC.:	<u>Police Work Area and Storage Reno</u>		<u>Rev7</u>
CONTACT:	<u>Derek Contizano</u>		

We are pleased to propose the following:

See attachment A

Sub-Total	\$	1,411,832.18
Coefficient	\$	84,709.93
Sales Tax Percentage (Current Tax Rate)	\$	79,289.05
General Liability Insurance Percentage (Actual Cost per Job Order)	\$	14,965.42
Builder's Risk Insurance Percentage (Actual Cost per Job Order)	\$	16,461.96
Payment Bond (Actual Cost per Job Order)	\$	17,958.51
Performance Bond (Actual Cost per Job Order)	\$	17,958.51
Owner Allowance		\$165,407.24
Grand Total	\$	1,808,582.79

CLARIFICATIONS

- 1) Work and Installation during normal business hours.
- 2) ASI 001 is included in the Grand Total above.
- 3) Removal of the bullet trap / steel plates is included in the Grand Total above.

EXCLUSIONS

- 1) Permits, architectural, engineering, drawings, as-builts, special inspections, materials testing.
- 2) Premium time unless otherwise indicated. Moving/relocating furniture/equipment unless otherwise indicated.
- 3) Any unforeseen conditions.
- 4) Any items/work not identified in the attached scope of work.

Thank you,

SDB, Inc.

Accepted by:

City of Chandler

Prepared by

Reviewed by

PROPOSAL
Attachment "A"

CUSTOMER:	City of Chandler	BID DATE:	
ADDRESS:	250 E Chicago Street	PROPOSAL NO.:	22-14-0007
	Chandler AZ 85225	PROPOSAL TYPE.:	Lump Sum
JOB DESC.:	Police Work Area and Storage Reno		
CONTACT:	Derek Contizano		

Via email:

Scope of Work: The proposed work includes work to be performed per the scope below for the project listed above.

- 1 Bid per City Approved Permit Set BLD22-3004 Date 9/30/2022 by Arrington Watkins
- 2 Excludes Permit, Permit Fee, FF&E, non-Code Signage, Special Inspection / Testing and Traffic Coating w/ Crickets.
- 3a Traffic coating is included in this revision at 129,330.58 and will not proceed without city approval.
- 4 Includes expansion joint without metal cover. Manufacturer strongly recommends against metal cover due to slope and movement of ramp.
- 5 All work to be performed during normal business hours with available access.
- 6 All sales tax is included.
- 7 Full time site supervision and associated contract administration is included.

We have attached Exhibit B-1 Fee Schedule and Exhibit B-2 Task - Hourly breakdowns and a milestone schedule for your review.

In submitting this long lead material proposal, we agree:

- To hold the proposal open for thirty (90) days after the date of this proposal.
- To commence with the construction within ten (10) days upon written notice to proceed.
- To accomplish the work in accordance with the JOC contract documents and the following clarifications, qualifications and exclusions listed below.

Clarifications:

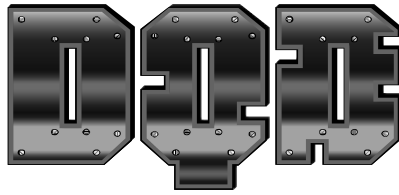
- 1 All work to be performed on straight time (7:00 am-3:30 pm). Shift work and overtime work excluded.
- 2 All work will be performed according to the General contractor's safety program.
- 3 Pricing is based on permitted drawings.

4 **Project Duration** 143 30

Exclusions: Construction (working days) Contract and Closeout (working days)

- 1 Any additional scope not stated in the scope above are hereby excluded
- 3 Allowances unless specifically noted in this proposal.
- 4 All permits and utility fees.
- 6 Seismic engineering or special support system.
- 7 Expediting.

Proposed Cost: SDB, Inc hereby proposes to complete the above mentioned project for the lump sum price of: \$ 1,808,582.79



DICKENS QUALITY DEMOLITION, LLC

"Experts in all Aspects of Demolition"

Proposal

Date: October 6, 2022

Attention: SDB

Project: Chandler Police Work Area & Storage

Dickens Quality Demolition will provide labor and all necessary equipment to accommodate the following:

- **Demolition and the removal of:** drywall partitions, furring, masonry wall openings and penetrations shown on A-2.0 (shoring/bracing by others), portion of slab for plumbing install, flooring in restroom area (assumed to be tile), plumbing fixtures/accessories, doors and frames, overhead doors, louver, window, ceilings grid, tectum panels, soffits, lights, and ductwork. This bid includes City of Chandler Badging, a NESHAP (for structural demo), necessary equipment, hauling, labor and supervision. This job will be performed Monday through Friday during the hours necessary to meet your schedule. **Due to current demand on the construction market and limited availability of man power, work will be scheduled at the time of contract as current manpower allows. Please see items not included.**
- **Items not included:** taxes, bonds, permits, asbestos survey, temp partitions, engineered demo plans, concrete coatings, epoxy flooring, mastic/underlayment/mud beds, Mechanical Units/Curbs, water supply, layout, X-ray/GPR, underground utilities, MP&E cutting and capping, and hazardous materials.

The above project will be completed in an efficient and professional manner for the sum of: \$52,357.00

Alternate:

Remove Bullet Trap System: Add \$3,500.00

Pricing will remain in effect for 20 (twenty) days from the above date. Dickens Quality Demolition assumes all salvage rights on the above project. Due to the current federal laws and regulations, the above project can not, and will not proceed without a proper hazardous materials survey on file at the office of Dickens Quality Demolition. If the above project involves any structural removal, a ten-day NESHAP notification must be filed with the county. Dickens Quality Demolition will be happy to assist the General Contractor/Building Owner in any way possible to help expedite necessary testing or notification requirements.

This proposal is based on 1 mobilization. Additional phases will be charged at \$1,500.00 each.

Any alterations or deviations from the specified scope of work will be completed upon written consent from authorized personnel. This proposal shall become part of the contract document and by signing you agree to all conditions listed within.



Craig Kotrys

Accepted by:

1111 N. 19th Avenue, Phoenix, Arizona 85009 (602) 258-8088 Fax (602) 258-8139
www.dickensquality.com
CR57 123622



Desert Vista Concrete

3136 N 28th Ave , Phoenix, AZ 85017

Proposal for City Of Chandler Police Work

Project: 220729 City Of Chandler Police Work

Owner:

Location: 250 East Chicago Street Chandler, AZ 85225

Owner No.:

Submitted To: SDB

Bid Date:

Attn: Sue Cardis

Bid Time:

Email: sue.cardis@sdb.com

Proposal Date: 10-04-2022

Proposal Items

No.	Description	Qty	UM	Unit Price	Total
1	Form & Pour New Sidewalk With 6" WWM, 4" Of ABC And Turn Down Edges At Landscaping 8" x 8" With 1-Each #4 Rebar Cont.	140.00	SF	\$37.67	\$5,273.80
2	Grind & Patch Existing Concrete Floor In Two Areas	160.00	SF	\$20.82	\$3,331.20
3	Striping & Parking Blocks	1.00	LS	\$5,040.00	\$5,040.00
Proposal Total					\$13,645.00

Conditions

- 1 Special Conditions**
- 1.01 All taxes, engineering, permits, bonds, staking, testing and inspection fees to be paid by Others.
 - 1.02 Bid is based on water being available on site for our use.
 - 1.03 Concrete priced as 3000 psi.
 - 1.04 Pricing is good for 30 days, after which the price is subject to change.
 - 1.05 Desert Vista Concrete will not guarantee flow on slopes less than 1%.
 - 1.06 All work is priced as one mobilization.
 - 1.07 Add \$1,850.00 for each additional mobilization.
 - 1.08 All soft dig, hard dig, and rock excavation is excluded and will be performed on a T&M basis.
 - 1.09 Adjustments of existing water lines and other utilities not included.
 - 1.1 Bid off of plan sheet A-1.2 and details on sheet A-9.1.1 only.
 - 1.11 Desert Vista will do their best to match colors & textures to adjacent concrete but cannot guarantee exact match.
 - 1.12 Concrete grade must be + or - 0.1' prior to starting.
 - 1.13 If project insurance requirements exceed Desert Vista Concrete's standard coverage, an additional cost will be incurred. Desert Vista Concrete insurance is available upon request.

Exclusions

- 2 Exclusions and Qualifications**
- 2.01 Excludes excavation, demolition, grading, compaction, and backfill.
 - 2.02 Excludes export of spoils.
 - 2.03 Excludes Traffic Control.
 - 2.04 Excludes barricades to protect our work areas.
 - 2.05 Excludes pipe bollards.
 - 2.06 Excludes rip rap.
 - 2.07 Excludes all surcharges, fees, and costs due to street moratoriums.
 - 2.08 Excludes striping.
 - 2.09 Excludes concrete pads for backflow cages
 - 2.1 Excludes backfill of all sidewalk, walls, curb and gutter
 - 2.11 Excludes clean up of others work
 - 2.12 Excludes ABC under concrete unless specified in above bid.
 - 2.13 Excludes water meters -- to be provided by others.
 - 2.14 Excludes concrete drains, french drains, trench drains.
 - 2.15 Excludes any and all lime stabilization.
 - 2.16 Excludes any and all demolition that isn't specifically listed.
 - 2.17 Excludes damage to concrete due to acts of nature.
 - 2.18 Excludes surveillance of concrete at conclusion of work day.

Submitted By:

John Reinhart (john@desertvistaconcrete@gmail.com)
Desert Vista Concrete

Date:

Accepted By:

Sue Cardis
SDB

Date:





PO Box 5277
Peoria, AZ 85385
(602) 942-1983 Main
(602) 978-8806 Fax
License 321570

Masonry Bid Proposal

Date: October 6, 2022

To: Sue Cardis - SDB

From: Melonie Leslie, President

Project: City of Chandler Police Work Area and Storage

Project Address: 250 E. Chicago St., Chandler, AZ

Masonry bid proposal:	\$ 47,500.00
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Inclusions:

- 1) Labor
- 2) Equipment
- 3) Block - 8-4-16 Founders Finish to match existing as close as possible but not exact **Lead time is 20 weeks minimum. Lead times may apply. Cement allocation currently in effect which may cause disruptions and lead time to standard stock materials.**
- 4) Mortar - **Lead time is 6 weeks minimum. Color pigment availability varies and limited integral color options may be available.**
- 5) Duro wire
- 6) Grout
- 7) Rebar (furnished and installed)
- 8) Set miscellaneous steel embeds (under 200 pounds only) as required at time of masonry construction (embeds furnished by others)
- 9) Infill three openings per T2
- 10) One new opening per T4
- 11) Twelve (12) new duct openings per T4
- 12) Masonry trash cleanup to dumpster (dumpster and dumpster removal to be provided by others)
- 13) Material, freight and fuel surcharges may apply if implemented by supplier after time of bid. If increases occur, a change order will be given for the difference in cost from time of bid to date of delivery to job site.
- 14) Material price escalations may apply to this project after date of executed contract if G & G Masonry has not received approved construction drawings (including RFI responses that would prohibit being able to place a valid material order), approved submittals, approved samples (including location designated material is to be used), approved shop drawings, definitive masonry scheduled start date (changes or delays in schedule may result in expiration of ready-mix pricing), ability to ship rebar and wire to a dry storage area on site.

Exclusions:

- 1) Caulking and sealing
- 2) Dry packing
- 3) Miscellaneous steel embeds, angles or lintels
- 4) Flashing
- 5) Footings
- 6) Crane hoisting
- 7) Site dust control
- 8) Sales tax
- 9) Bond
- 10) Permits
- 11) Water supply
- 12) Inspection/testing fees
- 13) Surveying
- 14) Pollution Insurance
- 15) Offsite storage of materials or off site storage insurance
- 16) Multiple movements of materials due to advance material procurement
- 17) Grout cancellation fees if grout has to be cancelled less than 24 hours from time of pour due to reasons unrelated to G & G Masonry LLC other than weather events

Bid proposal based on:

- 1) Drawings Dated 9/7/22

Note: The above bid proposal is valid for 20 days. Proposal subject to change due to market increases, fuel/energy surcharges, freight rate increases, lodging/per diem increases or changes to construction documents. Bid proposal subject to receiving a job specific AZ5005 form. Sufficient survey points and/or corner pins and/or gridlines must be provided to us in order to layout the building. Contract acceptance contingent on schedule availability of G&G Masonry LLC and incorporation of inclusions and exclusions into subcontract.



SKYCE STEEL INC.

October 26, 2022

4320 E. Magnolia St.
Phoenix, AZ. 85034

Phone: 602.237.1085
Fax: 602.237.3332

To: SDB

Project: COC Police Work and Storage Area

Attn: Sue Cardis

Project Location: 250 Chicago, Chandler, AZ

Proposal Number: 10466 R1

Fabricated and Erected items (UNO):

(4) Low wall posts and horizontal tube steel as indicated on S2.1

(4) Lintels per T4/S1.1 and T16/S1.2

(2) Bollards (FOB Jobsite)

(2) Infill at double tee opening @ parking garage per T17 or T22/S1.2

(1) Bent plate ledger at parking garage per T20/S1.2

Certified welding (AWS D1.1)

Prime paint where applicable

Freight allowed to jobsite of all SSI fabrications

Hoisting and safety equipment applicable to this type of work

Multiple mobilizations anticipated

Detailed shop and erection drawings for approval prior to any fabrication

PRICING:**TOTAL: \$24,389.00**

Plus, Applicable Sales or Use Tax FOB Jobsite (This Quote is Valid for **15** days.)

STANDARD EXCLUSIONS:

Engineering or engineer stamped shop drawings; Taxes UNO; Bonds; Installation of any embedded item (UNO); Lay out including elevation of any embed (for other than steel to steel connection); Any flashings or reglets of any kind; Chain link fencing or gates; Safety cable removal or maintenance after SSI job completion; Any penetrations cut in any steel or steel decking (for other trades); Setting of final elevation nut at columns; Dry pack at columns; Simpson products of any kind; Special inspections of any kind; Any abrasives applied or machined in or on access ladder rungs; Aluminum or stainless steel of any kind (UNO); Connection bolts for other trades; Anchor bolts for light polls; Anchor bolts for other trades; Miscellaneous steel items expressed or implied in plumbing, electrical or mechanical drawings; Bike racks (UNO); Roof hatches; Bilco Products; Unistrut; Installation of any lintel under 300 pounds; Primer or paint on any item specified to be provided with galvanized finish (primer and finish paint "by others"); Paint other than one (1) coat shop primer; ANY other work or supplied material not listed above.

JOB SPECIFIC EXCLUSIONS:

Testing costs, off hour work, demolition of any type, barricades at parking garage, saw cutting for lintels, grout fill at CMU @ new openings/Lintels

RESPONSIBILITY OF THE CONTRACTOR:

RETAINAGE: 10% retainage will be withheld only until 50% of the work contained herein has been satisfactorily completed. At that time retainage will be reduced to 5%. In addition, 50% of the previously held retention monies will be released to Skyce Steel Inc. within 30 calendar days. Upon substantial completion of the contract, all retention held to date will be due within 30 calendar days.

PAYMENT: Invoices shall be presented to the contractor every 30 days. From the last day of the invoice's respective month, the invoice will be payable to Skyce Steel Inc. within 30 calendar days. In addition, the Arizona prompt pay laws will apply.

DETAILING: Detailing is an integral part of the fabrication process as such time is of the essence. Upon delivering to the contractor the first-round submittal packages an invoice will be generated for the presented detailing, this invoice will be payable 30 days from receipt, in full, no retention allowed.

TERMS AND CONDITIONS:

1. AISC Specifications and provisions will apply and prevail
2. All fabrication and erection performed by Skyce Steel Inc. will be carried out with strict adherence to AISC specifications, thirteenth addition.
3. Clear and reasonable access as deemed necessary by AISC standards and SSI will be provided by the contractor in and or around the construction site as required for cranes, equipment or material egress.
4. This estimate is based on a normal 40-hour work week; any acceleration in schedule will result in additional overtime rates.
5. Any changes and/or additions to proposal/contract scope of work will result in written changes orders for said changes, agreed upon by both parties.
6. This proposal (Skyce Steel Inc. proposal number 10466 R1) will be included as an attachment to the contractor's standard form contract, the scope of work, exclusions (standard and site specific), Responsibility of the contractor and the terms of condition sections of this proposal will be included in said contract.

ACCEPTANCE OF PROPOSAL:

Skyce Steel Inc. Representative:

By: _____

Its: _____

Date: _____

Contractors Representative:

By: _____

Its: _____

Date: _____

We wish to thank you for allowing us to quote on this requirement.

We hope we can be of service to you on this and future projects.

Sincerely,

Fred Keck

Sr. Project Manager

Skyce Steel Inc.

fred.keck@skycesteel.com

Project Name: City of Chandler, Arizona Police Work Area and Storage Renovation		Date: September 30, 2022	
Project Address: 250 E. Chicago St. Chandler, Arizona 85225			
Plan Date: 9.7.22	Specifications Included:		Addendum:
Attention: Sue Cardis / Todd Newberry	1604 Specialties Estimator: Roy Bellotte 480-238-2414	Proposal # /Reference #: 4383	1604 Specialties Revision:

We hereby submit specifications and estimates for: Building Insulation

Furnish and install R-38 un-faced batt insulation with white scrim mechanically affixed in place at underside of double tee deck. - \$21,756.00
 Furnish and install R-19 un-faced batt insulation at exterior furring. (R20 is currently not available)
 Furnish and install R-19 un-faced batt insulation at interior partitions where graphically noted only, typical picture below.
 Furnish and install R-11 un-faced batt insulation at interior partitions where graphically noted only, typical picture below.



Add-Alt: Furnish and install R-19 un-faced batt insulation in hard lid framing at restrooms; please add to base bid: \$194.00

****If material is not delivered to the site prior to December 1st, 2022; please add material escalation costs: \$1,785.00**

TOTAL BASE BID \$25,632.00

We hereby submit specifications and estimates for: Acoustical Joint Sealant

Furnish and install acoustical sealant at head and base of all new interior gypsum partitions as occurs.

Add-Alt: Furnish and install acoustical sealant at head and base at interior face of exterior furring; please add to base bid: \$2,358.00

TOTAL BASE BID \$3,962.00

We hereby submit specifications and estimates for: Joint Sealants

Furnish and install sealants at the following locations:

Scope + Dimensions	Area	Additional Info	Material	Included in Base Bid? Yes/No/Add-Alt	Total LF	Base Bid Price
Remove and Replace Existing Failed Head of Wall Sealant at CMU to Double Tee Deck at Exterior Partition at Line ~13	Exterior Wall	Job Walk Observation	Urethane	Add-Alt	706	\$5,198
Existing Interior PCCP Paving CCJ's - .125"	Interior	103/A9.1.1; A5.6-Finish Schedule CONC-1	Urethane	Add-Alt	1,461	\$3,866
Furring at Wall Corner - .5"	Interior	503/A9.5.1	Acrylic	Add-Alt	14	\$35
PCCP Slab/Sidewalk to Structure - .5"	Site	103/A9.1.1; 203/A-9.2.1	Urethane	Yes	5	\$33
PCCP Sidewalk New to Existing - .5"	Site	103/A9.1.1	Urethane	Yes	5	\$33
Exterior Hollow Metal Door Frame - .375"	Structure	210,211,203,202,201/A9.2.1	Urethane	Yes	36	\$94
Exterior Aluminum Storefront/Windows - .375"	Structure	204,205/A9.2.1; 213,214,215/A9.2.2	Silicone	Add-Alt	304	\$898

TOTAL BASE BID \$500.00 Minimum

We hereby submit specifications and estimates for: Traffic Coating

Remove existing coating from deck. \$24,592.00

Furnish and install 3-part urethane deck coating system as manufactured by Tremco, type 350/346/346. \$65,413.00

Add-Alt: Clean/repair existing deck coating, add new intermediate coat and topcoat in lieu of 100% new system: \$46,884.00

****If material is not delivered to the site prior to January 1st, 2022; please add material escalation costs: \$5,200.00**

TOTAL BASE BID \$90,005.00



**1604 SPECIALTIES
LLC**

When Life Depends on Mills

We hereby submit specifications and estimates for: Mechanical Expansion Joint Covers

Furnish and install mechanical expansion joint cover at the following areas:

Scope + Dimensions	Area	Additional Info	Material	Included in Base Bid? Yes/No/Add-Alt	Total LF	Base Bid Price
Mechanical Expansion Joint	Parking Garage	A-1.2	EMSEAL 2" SJS/Non-Rated/Aluminum Cover Plate	Yes	25	\$9,042
Demo of Existing Joint	Parking Garage			No	25	\$0
Infill of Existing Block Out	Parking Garage			No	25	\$0

TOTAL BASE BID \$9,042.00

We hereby submit specifications and estimates for: City of Chandler Badging

Please apply \$500.00 per contracted scope to cover badging.

PLEASE APPLY PER SCOPE..... \$500.00

A Note to Our Clients:

Dear customers,

The insulation and sealants industry is currently experiencing material disruptions across the board which have caused unprecedented price increases. Since 1st quarter of 2021 we have seen an increase of over 25% on just insulation pricing. The current projection through the 4th quarter of 2022 is another 30% increase. 1604 Specialties is doing whatever we can to help mitigate these additional costs.

We appreciate your understanding and continued patronage during this turbulent time.

Ben Poulsen

Standard Qualifications:

1. Add 4% for payment and performance bond, minimum \$600.00 charge per contract if required.
2. Taxes are excluded unless noted otherwise.
3. Textura fees are specifically excluded unless noted otherwise.
4. Unless specifically noted above, this contractor has not reviewed the onsite conditions of the project at the time this proposal was offered.
5. All insulation products offered in this proposal shall be considered to be type 1, ASTM C665, unless noted otherwise above.
6. This proposal its associated qualifications and conditions shall be included with the contract documents as an attachment.
7. No back charges will be issued to 1604 Specialties without issuance of a forty-eight-hour written notice.
8. Furnishing of temporary facilities and power, such as light, electrical, water and toilets is excluded.
9. Any damage to 1604 Specialties work, which is not specifically caused by 1604 Specialties, will be considered damage by other trades. It is the responsibility of the Primary Contractor to coordinate the project, as such, 1604 Specialties, will be compensated for any repairs of damage by others through change orders to 1604 Specialties contract with the Primary Contractor.
10. Payment due for materials stocked on-site or in an approved warehouse.
11. Protection of work is to pass to the general contractor after the completion of each phase of work.
12. Work to proceed sequentially with areas free of debris and obstacles to provide efficient productivity.
13. All hoisting and dump bins shall be provided by the general contractor at no cost to 1604 Specialties.
14. All demolition shall be by others.
15. Retention shall be released upon scope completion.
16. Working hours are defined as Monday through Friday first shift excluding holidays.
17. All prices are quoted on a 30-day guarantee. Contract or a letter of intent is required to lock in proposed pricing.
18. A complete set of contract documents shall be issued to this contractor to include drawings, specifications, addendums and any other necessary documents.
19. See additional job specific required conditions attached below.

TERMS: NET 30 DAYS.

1 ½% ON PAST DUE BALANCE.

NOTE: This proposal may be withdrawn if not accepted within 30 days.

PROPOSAL SUBMITTED BY:

1604 Specialties LLC

Roy Bellotte, Senior Project Manager

September 30, 2022

Date of proposal

PROPOSAL ACCEPTANCE:

The above prices, specifications and conditions are satisfactory and are hereby accepted. You are authorized to do the work as specified. Payment will be made as outlined above.

Authorized Signature

Authorized by

Date of Acceptance

Customer P.O. #



1604 SPECIALTIES LLC

When Life Depends on Mills

All material is guaranteed to be as specified. All work to be completed in a workmanlike manner according to our standard practices. Any alteration or deviation from above specifications involving extra costs will be executed only upon written orders and will become an extra charge over and above the estimate. All agreements contingent upon strikes, accidents or delays beyond our control. Owner to carry fire, tornado, and other necessary insurance. Our workers are fully covered by Workmen's Compensation Insurance.

Job Specific Qualifications Specialty Insulation Applications:

1. Unless specifically noted above, this contractor has not reviewed the onsite conditions of the project at the time this proposal was offered.
2. Unless specifically noted above, insulation of king studs, boxed headers or door frames is specifically excluded.
3. Unless specifically noted above, "chinking" or foam sealants at windows, doors or framing of any kind is specifically excluded.
4. The primary contractor shall provide all weather protection as is necessary during the installation and curing process to include tenting/enclosures, ventilation and heating as is necessary.
5. The primary contractor shall provide all necessary electrical hookups to within 100' of the work area to include up to 220V 50Amp power and a dedicated spider box for 120V power.
6. The primary contractor shall provide an adequate water supply of potable water of up to 3000 gallons per day as well as any necessary connections. The primary contractor shall be liable for any metering requirements or fees.
7. All surfaces to receive Specialty Insulation, shall be readied and presented free of paint, primers, oil, grease or loose mill scale. The primary contractor shall perform and pay for any cleaning determined as necessary.
8. There shall be no loading of floors with materials prior to the installation of overhead Specialty Insulation.
9. Prior to the installation of overhead Specialty Insulation, all necessary clips, hangers or supports for the overhead MEP shall be in place and shall protrude from the roof deck vertically down no greater than 6". The primary contractor shall be responsible to protect any MEP hangers.
10. Construction of framing of any kind shall be deferred until after installation of the overhead Specialty Insulation.
11. All concrete pours on metal decks shall be completed and cured prior to the installation of overhead Specialty Insulation.
12. No above deck activity of any kind shall occur during installation or curing of the products.
13. This contractor shall provide daily clean-up for its own trade and shall not be available for composite clean up. Floors shall be left in a broom clean condition.
14. The primary contractor shall provide an area with adequate room for necessary equipment as well as lay down areas convenient to the areas to be treated.
15. Testing of any kind as well as associated costs are excluded and shall be provided by the primary contractor including but not limited to: 3rd party inspections, compatibility testing, engineering judgments, wet stamps, etcetera.
16. Mobilizations Included: 2 / Additional mobilizations to be billed at \$500.00 each.

Unit Pricing:

1. Wages – Time charged will include drive time from yard to jobsite to yard.
 - a. Superintendent: \$61.25 per hour
 - b. Foreman: \$55.86 per hour
 - c. Journeyman: \$42.21 per hour
 - d. Apprentice: \$33.71 per hour
2. Subsistence / (Travel time is not included)
 - a. \$100.00 per day
3. Equipment
 - a. Ladder: \$20.00 per day
 - b. Aerial Lift no greater than 20': \$175.00 per day. Minimum of 3 days.
 - c. Rolling Scaffold (standard 10', non-pneumatic tires): \$90.00 per day
 - d. Vehicle: \$60.00 per day
4. Material (Freight is not included)
 - a. R-11 Un-faced Batt Insulation Type 1, ASTM C 665: \$70.65 bag
 - b. R-19 Un-faced Batt Insulation Type 1, ASTM C 665: \$61.33 bag
 - c. R-30 Un-faced Batt Insulation Type 1, ASTM C 665: \$61.18 bag

Job Specific Qualifications Specialty Fire-Stop, Smoke Stop and Acoustical Sealant Applications:

1. Unless specifically noted above, this contractor has not reviewed the onsite conditions of the project at the time this proposal was offered.
2. The primary contractor shall provide all weather protection as is necessary during the installation and curing process to include tenting/enclosures, ventilation and heating as is necessary.
3. The primary contractor shall provide all necessary electrical hookups to within 100' of the work area to include up to 220V 50Amp power and a dedicated spider box for 120V power.
4. The primary contractor shall provide an adequate water supply of potable water as well as any necessary connections. The primary contractor shall be liable for any metering requirements or fees.
5. All surfaces to receive firestop shall be readied and presented free of paint, primers, oil, grease or loose mill scale. The primary contractor shall perform and pay for any cleaning determined as necessary.
6. There shall be no loading of floors with materials prior to the installation of firestopping which would impede a productive install.



**1604 SPECIALTIES
LLC**

When Life Depends on Mills

7. This contractor shall provide daily clean-up for its own trade and shall not be available for composite clean up. Floors shall be left in a broom clean condition.
8. The primary contractor shall provide an area with adequate room for necessary equipment as well as lay down areas convenient to the areas to be treated.
9. Testing of any kind as well as associated costs are excluded and shall be provided by the primary contractor including but not limited to: 3rd party inspections, compatibility testing, engineering judgments, wet stamps, etcetera.
10. Water, Thermal and Leakage ratings, WTL, are specifically excluded unless specifically noted otherwise in the specific proposal.
11. Firestop labeling of any kind is specifically excluded unless noted otherwise.
12. Treatment of MEP Trade penetrations of any kind is specifically excluded unless noted otherwise.
13. Mobilizations Included: 1 / Additional mobilizations to be billed at \$500.00 each.

Unit Pricing:

1. Wages – Time charged will include drive time from yard to jobsite to yard.
 - a. Superintendent: \$61.25 per hour
 - b. Foreman: \$55.86 per hour
 - c. Journeyman: \$42.21 per hour
 - d. Apprentice: \$33.71 per hour
2. Subsistence / (Travel time is not included)
 - a. \$100.00 per day
3. Equipment
 - a. Ladder: \$20.00 per day
 - d. Aerial Lift no greater than 20': \$175.00 per day. Minimum of 3 days.
 - b. Rolling Scaffold (standard 10', non-pneumatic tires): \$90.00 per day
 - c. Vehicle: \$60.00 per day
4. Material (Freight is not included)
 - a. Spray applied Elastomeric firestop spray: \$221.00 Bucket
 - b. Elastomeric Firestop Sealant: \$227.00 Bucket
 - c. Acoustical Spray: \$212.98 Bucket
 - d. Acoustical Caulking: \$148.00 Bucket
 - e. Mineral Wool 4"X24"X48"X4#: \$95.48 bag

Job Specific Qualifications Specialty Joint Sealants and Waterproofing Applications:

1. Unless specifically noted above, this contractor has not reviewed the onsite conditions of the project at the time this proposal was offered.
2. The primary contractor shall provide all weather protection as is necessary during the installation and curing process to include tenting/enclosures, ventilation and heating as is necessary.
3. The primary contractor shall provide all necessary electrical hookups to within 100' of the work area to include up to 220V 50Amp power and a dedicated spider box for 120V power.
4. The primary contractor shall provide an adequate water supply of potable water as well as any necessary connections. The primary contractor shall be liable for any metering requirements or fees.
5. All surfaces to receive joint sealants shall be readied and presented free of paint, primers, oil, grease or loose mill scale. The primary contractor shall perform and pay for any cleaning determined as necessary.
6. This contractor shall provide daily clean-up for its own trade and shall not be available for composite clean up. Floors shall be left in a broom clean condition.
7. The primary contractor shall provide an area with adequate room for necessary equipment as well as lay down areas convenient to the areas to be treated.
8. Unless specifically noted above this proposal qualifies standard colors only.
9. Testing of any kind as well as associated costs are excluded and shall be provided by the primary contractor including but not limited to: 3rd party inspections, compatibility testing, engineering judgments, wet stamps, etcetera.
10. Mobilizations Included: 1 for elevations above 9' and 1 for elevations below 9' / Additional mobilizations to be billed at \$500.00 each.

Unit Pricing:

1. Wages – Time charged will include drive time from yard to jobsite to yard.
 - a. Superintendent: \$61.25 per hour
 - b. Foreman: \$55.86 per hour
 - c. Journeyman: \$42.21 per hour
 - d. Apprentice: \$33.71 per hour
2. Subsistence / (Travel time is not included)
 - a. \$100.00 per day
3. Equipment
 - a. Ladder: \$20.00 per day
 - e. Aerial Lift no greater than 20': \$175.00 per day. Minimum of 3 days.



1604 SPECIALTIES
LLC

When Life Depends on Mills

- b. Rolling Scaffold (standard 10', non-pneumatic tires): \$90.00 per day
- c. Vehicle: \$60.00 per day
- 4. Material (Freight is not included)
 - a. 2 Part Urethane Sealant: \$72.04 Bucket
 - b. Silicone Sealant: \$98.47 Bucket
 - c. 7/8" Open Cell Backerrod: \$98.48 Per Bag



1604 SPECIALTIES
LLC

Date: 9-30-2022
To: SDB Inc.
Attn: Sue Cardis sue.cardis@sdb.com
Re: City of Chandler Police Office Renovation TI

Per your request we have provided the following quotation for the above referenced project including labor, materials, safety setup and removal and loading.

Additional Services: Invoice rate; \$75.00 per man hour, plus required materials

SCOPE OF WORK: Flash in 6 condenser curbs, 1 OU hood, Gravity curb 1 and 14 pipes.

- 1) Clean surrounding roof system to receive new material as needed.
- 2) Flash in (6) new condenser curbs and detail per manufacturers specifications.
- 3) Flash in (1) OU unit and detail per specifications.
- 4) Install (1) Gravity vent and detail per specifications.
- 5) Install (14) new water and refrigerant lines stubbed up through roof.
- 6) Clean related roofing debris and discard accordingly.
- 7) All existing warranties and guarantees will stay intact upon completion.

Alternate Add: If Walk Pads are wanted by owner add \$45.00 per LF.

****NOTE****

NTE 137 LF of new curb flashing.

NTE 14 pipe flashings.

Base Bid price.....\$14,876.00 (Sales Tax Included)

Clarification:

- Global Roofing is not responsible for carpentry, framing, cutting out decking, sheet metals of any kind. When cutting out for new penetrations GC must keep in mind that the cutout should not exceed 6" larger than each curb dimension.
- Demolition of existing mechanical units, duct work etc. or cutting of structural decking, screen wall installation is excluded. All safety related covers or temporary coverings at open curb locations are the responsibility of the GC / Owner.
- Contractor shall provide a minimum of (2) weeks' notice prior to disturbing the watertight integrity of existing roof system. Global Roofing Group shall not be held liable in any way for leaks prior to our scope of work being performed.
- Any penetrations not ready for Global Roofing Group when mobilized will incur an additional \$900.00 trip charge which must be signed off and a change order processed prior to remobilization.
- Excludes lead flashings, equipment curbs, wood blocking, nailers, sheathing, waterproofing, damp-proofing and water testing of any kind.
- Exclude all sheet metal unless specifically noted in above scope of work.
- All roof decks MUST be ready for installations or Tenant Improvements prior to mobilization.
- Excludes Permits, Bonds, Textura Fees, and some insurance requirements.
- Quote is good for 15 days.

Please provide the following information:

Invoice to: _____

Phone: _____

Address: _____

Fax: _____

City, St., Zip. _____

EM: _____

Contractor's Lic. No.: _____

Please sign and return this agreement and services will be scheduled. Be aware that no services can be scheduled without this executed agreement.

Sincerely,
Global Roofing Group
Ray Chaffee
Ray Chaffee
Project Manager Commercial Division
P: 480.752.8550 C: 480.514.0162
rchaffee@globalrsw.com

Acceptance of Proposal:

Owner/Authorized Agent

Date

KELLEY

ESTABLISHED IN 1886



PROPOSAL

Phoenix Office L-05 Arizona Contr. License # 102509

3440 N 27th Avenue, Phoenix, AZ 85017

FX: 602.254.5224 PH: 602.254.5967

We are pleased to present this quotation per architectural plan pages dated
ADDENDUM:

PROJECT: City of Chandler Police Work Area and Storage Renovation

STEEL DOORS & FRAMES

***\$9,627.00**

- 02 EA **CURRIES** HOLLOW METAL 18ga DOORS
- 09 EA **CURRIES** HOLLOW METAL 16ga 3-SIDED FRAMES
- 05 EA **CURRIES** HOLLOW METAL 16ga SIDELITE FRAMES

WOOD DOORS

***\$9,856.00**

- 12 EA **VT** QUARTER SLICED SELECT WHITE MAPLE

PREMACHINED, FACTORY FINISHED

DOOR HARDWARE

***\$15,808.00**

Schlage LOCKSETS, **LCN** CLOSERS, **Von Duprin** EXIT DEVICES

*DUE TO VOLATILE SUPPLY/MATERIAL MARKET PROPOSAL CAN ONLY BE HELD FOR 30-DAYS

Exclusions: Responsibility for work and materials **not part of the above sections, unless specifically noted otherwise.** These include tax, bonds, unloading, delivery, installation, glass, glazing, painting, pre-finishing, fieldwork, measuring, field splicing, frame installation, grouting, low voltage connections, lock boxes and bituminous coating (**asphaltic emulsion**). This bid is based on an estimate and should not be considered per a fully engineered project. Kelley Bros will not be held responsible for any missing or incorrect items in the plans and specifications during the estimating and bidding process or the engineering process if awarded the project. Any discrepancies that are found in the bidding or post award engineering process will be noted accordingly. **Kelley Bros of Arizona always excludes installation of hardware for gates, overhead doors, glass doors & aluminum openings.**

This quotation on material requested is **FOB PHX, tailgate delivery**, freight allowed to jobsite, **30-day terms**, material billed in-store, and subject to credit approval. Allow time for special material orders to clear factory to estimate approximate shipping time. Use this Proposal as your purchase order by signing the Acceptance and returning one copy to our office. **Quote good for 30 days.** Notify our office for time extension if required.

Quoted By: Belinda Orosco Acceptance: _____

Date: 10/07/2022 Date: _____



Entrances
Storefronts
Curtain Walls
Structural Glass Walls

1141 W. Grant Street
Phoenix Arizona 85007
PH: (602) 258-5000 FAX (602) 258-3204
ROC: L-65 06877 & C-65 04522

Proposal Submitted To: SDB

Phone:

Date: 9/30/22

Fax:

Street:

Job Name Chandler Police Work Area

City, State and Zip Code:

Job Location:

Architect::

Date of Plans:

Job Phone:

Furnish and install 2" x 4 1/2" center glaze thermally broken for 1" glazing aluminum storefronts with a dark bronze anodized finish.

One (1) 9'-0" x 10'-0" entry (1006B)

One (1) 9'-0" x 9'-0" fixed

Two (2) 6'-0" x 7'-0" fixed

One (1) 6'-0" x 7'-0" entry (1004A)

Furnish and install wide stile with 12" bottom rails, 6" mid-rails thermally broken aluminum storefront doors.

Two (2) 3'-0" x 7'-0" singles (door #100bB with hardware set 07 & door #1004A with hardware set 04)

Furnish and install 1" dual pane glass (1/4" guardian SNX5123 #2 tempered/1/2" space/1/4" clear tempered) @ exterior storefronts & entries.

Furnish and install 3M Ultra S800 security film @ exterior aluminum storefront and entries glass.

Furnish and install 1/4" clear tempered glass in frames furnished and installed by others.

Five (5) typeF01E door frames.

Caulk exterior perimeters of aluminum storefronts and entries

Shop drawings

**Base Bid \$50,660.00
+ sales tax \$2,832.00**

Exclude: Sales Taxes, Permits, Bonding, Cleaning & Protection After Installation & Mirrors.

We propose hereby to furnish materials and labor to complete in accordance with the above for the sum of:

Dollars

Payment to be made as follows:

All materials are guaranteed to be as specified.

All work to be completed in a workmanlike manner according to standard practices.

Any alterations or deviations from above specifications involving extra costs will be executed only upon written orders, and will become an extra charge over and above the estimate.

All agreements contingent upon strikes, accidents or delays beyond our control. Owner to carry fire, tornado and other necessary insurance.

Our workers are fully covered by Workman's Compensation.

Note: This proposal may be withdrawn if not accepted within 30 days.

Authorized Signature BRIAN WILSON

Acceptance of Proposal- The above prices, specifications and conditions are satisfactory and are hereby accepted. You are authorized to do the work specified. Payments will be made as outlined above.

Authorized Signature

Note: If additional insured endorsements is to include products/completed operations (Form CG20-10-11-85 or Equivalent) there is a \$500.00 per entity/\$1100.00 maximum charge per project.



Western Wallboard

480-262-2867 ROC# 324545

1375 S. Mountain View Rd.
Apache junction, AZ 85119
cmartin@westernwallboard.com * Clint Martin 480-262-2867

Proposal created for:	Project name:
SDB	City of Chandler Police Work Area and Storage Renovation
Attention:	Project address:
Sue Cardis	250 East Chicago Street, Chandler, AZ 85225

Date submitted:	Architect:	Date of plans:
9/30/22	AWA	9/7/22

Description:

Metal framing & Drywall:

- Furnish and install new metal framed full height walls, partitions & partial height walls according to the floor plan and wall legend of the drawings dated above.
- Install hollow metal door frames in new metal framed walls. (Frames provided by others). Frames must be onsite during wall framing. Excludes door and hardware installation.
- Furnish and install flat strap metal backing for wall mounted accessories where required.
- Furnish and install metal framed suspended gypsum board ceilings and soffits according to the reflected ceiling plan and associated details.
- Furnish and install drywall on new metal framing, taped and textured to match existing. Moisture resistant drywall where required.
- Includes badging.

We hereby purpose to furnish material & labor in accordance with the above specification,
for the sum of:

	(\$ 107,700.00
Add if tax is required:	(\$ 2,650.00
Payment to be made as follows: Monthly progress payments.	

Respectfully submitted.

Acceptance of proposal - I hereby authorize all work as specified. Payment to be remitted as outline above.	
Date Authorized:	Proposal valid until: 30 days
X.	X.

sunset acoustics, inc.

5670 N. 51st Ave., Glendale, AZ 85301
ph.602.269.0431 fax.602.269.0432
License - #ROC-197354
serving arizona since 1986

BID PROPOSAL

Date: 10/6/2022

PROJECT: CITY OF CHANDLER POLICE WORK AND STORAGE

250 E. CHICAGO ST.
CHANDLER, AZ 85225

TO: SDB

INCLUSIONS: SPECS: 095123 ACOUSTICAL TILE CEILINGS
ADDN: NONE

ARCH: ARRINGTON WATKINS ARCHITECTS
PLAN: DATED 9-7-22

GRID- 2x2 9/16" SUPRAFINE NARROW FACED WHITE SUSPENSION SYSTEM
TRIM- ARMSTRONG AXIOM 2" WHITE AT FLOATING CEILINGS
TILE- ARMSTRONG #1942 ULTIMA HIGH NRC WHITE TEGULAR EDGE - 2x2x7/8"
LIGHTS- PROVIDE #12ga LIGHT SLACK SAFTEY WIRES - RECESSED 2 per LIGHT, CAN LIGHT 1 per LIGHT
FINAL FIXTURE CONNECTION TO LIGHTS BY OTHERS

CONDITIONS: Project to be free and clear of obstructions or debris that may affect continuous uninterrupted installation
Other trades work to be complete and fully inspected prior to installation
Work to be performed during normal working hours Monday thru Friday
Dumpsters for trash disposal to be furnished at no additional charge
Parking to be provided at no additional charge

EXCLUSIONS: Bond,Permits, Dumpsters & Fees, Repair or replace damage or removal by others,
Connect light slack wires to lights, Mech. Diffuser support wires or screw attachments,
Seismic lateral force splay wires/perimeter wires/Compression posts, Acoustical sealants or caulking,
Tile cut outs-Can Lights/Exit Signs/Speakers/Alarm, Sprinkler tile cuts prior to full tile installation,
Tile installation or perimeter cuts prior to final inspection and full tile installtion, 8 or 9ga. Wire,

BASE BID: \$ 43,900.00

Sales Tax: \$ 2,590.00 Tax #07431788F

TOTAL BID: \$ 46,490.00 (Price good for 30 Days)

ALTERNATES: NONE

NOTE/OTHER: NONE

PROPOSAL SUBMITTED BY: DAVID R. THORSTENSEN

Email -

dave@sunset-az.com



red
commercial flooring llc
602-738-8590
ROC# 267300 ■ PPFB Since 2010

October 4, 2022

SDB

City of Chandler Police Work Area

Listed below you will find the breakdown for the above referenced project.

Carpet & Resilient Bid

	Quantity	Unit
Furnish & Install: Cpt - Mohawk Solve II 955 Iridescent 24" tile	117.37	SY
Furnish & Install: 4" Roppe Rubber Base color Black Brown	1200	LF

Carpet & Resilient: **\$6,287.86**

Ceramic Bid

Furnish & Install: CT2 - American Olean unglazed mosaic Oao6 Stormy 2"x2"	216	SF
Furnish & Install: CT1 - Marazzi Alteration AT61 Cotton 12"x24"	844.8	SF
Furnish & Install: Schluter Dilex Base AHK	90	LF

Ceramic: **\$12,289.93**

Concrete Bid

Furnish & Install: Polished Concrete- Salt & Pepper - No Spec	6811	SF
Furnish & Install:		

Concrete: **\$37,460.50**

Subtotal:	\$56,588
Tax:	\$629
Grand Total:	\$57,217

Exclusions: Demolition, furniture moving, major floor prep, floor leveling, concrete grinding, moisture tests, special equipment rental, protection from other trades, dust control, vacuuming, final cleaning, grout/tile sealing, cleaning and waxing of any floor, attic stock, bonding expenses, weekend and/or after hours work, and all applicable taxes, unless otherwise noted above.

Thank you,
Bobby G. Avery
Bobby G. Avery

PHP Commercial Painting

2202 W. Lone Cactus Dr. #9 | Phoenix, Arizona 85027 | P 623.900.4747 | F 623.322.4645

Licensed / Bonded / Insured

ROC282670

www.PHPpainting.com

Submitted to:

SDB Inc.
1001 S Edward Dr
Tempe, AZ 85281

Phone: 480-317-5752

Email: sue.cardis@sdb.com

Work to be performed at:

Chandler Police Work Area & Storage
250 E Chicago St
Chandler, AZ 85225

Date: September 30, 2022

Attn: Sue Cardis

Description of Work:**Proposal****Painting to include:**

- Specified interior walls, gyp ceilings & open deck
- Specified doors & jambs
- Specified bollards

Notes:

1. Division 9 - Painting
2. Received no addendum
3. Received plans dated 09/07/22

Exclusions:

1. Patching, texturing or repairs of any substrates
2. Floor coatings, markings, paints, epoxies or sealants
3. Wall coverings, signage or graphics installation or removal
4. Parking lot markings or curbing
5. Mechanical & general storage
6. Ext infills

Pricing:

Labor, Material & Equipment:

Tax/Add:

Painting

\$19,550.00

\$275.00

**** The General Contractor is responsible for determining the type of TPT Contract. For an MRRA (Maintenance, Repair, Replacement, and Alteration) Bid/Contract, all sales tax is paid on materials at the point of purchase. If this bid/contract will be considered as a "Modification" by a prime contractor, please provide an AZDOR Form 5005. If either is the case, we need to be informed prior to signing a contract so as to add tax or if proposal will remain as is. Submitted by Trevor McCullough**

PHP Commercial Painting

2202 W. Lone Cactus Dr. #9 | Phoenix, Arizona 85027 | P 623.900.4747 | F 623.322.4645

Licensed / Bonded / Insured

ROC282670

www.PHPpainting.com

Submitted to:

SDB Inc.
1001 S Edward Dr
Tempe, AZ 85281

Phone: 480-317-5752

Email: sue.cardis@sdb.com

Work to be performed at:

Chandler Police Work Area & Storage
250 E Chicago St
Chandler, AZ 85225

Date: September 30, 2022

Attn: Sue Cardis

"The Fine Print"

1. Sales tax exempt "prime contractors" must provide a completed ADOR 5005 form or sales tax will be added to all pricing.
2. Above work to be performed as noted and completed in a workmanlike manner.
3. Past due payments will accrue a finance charge of 1.5% per month plus costs of collection and attorney fees should legal action be required.
4. All agreements are contingent upon strikes, accidents, or delays beyond our control.
5. This proposal will expire in 30 days unless agreed upon by both parties.
6. Insurance certificates requiring "Primary Non-Contributory", or "Waiver of Subrogation" may be additional to this quote.
7. Performance and payment bonds are additional to this quote.
8. Any alteration or deviation from above specifications involving extra costs will be executed only upon written order, and will become an extra charge over and above the estimate with a standard labor rate of \$75 and a premium labor rate of \$90 per man-hour + a material cost marked up 20%.

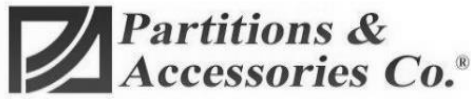
Agreement:

Respectfully Submitted _____ Date: _____
Trevor McCullough 602-680-9806 cell trevor@phppainting.com

The above prices, specifications and conditions are satisfactory and are hereby accepted. You are authorized to do the work as specified.
Payments will be made as outlined above.

Signature _____ Date: _____

ACCEPTANCE OF PROPOSAL



www.partitionsco.com

1220 South Pasadena Mesa, AZ 85210
Phone (480) 969-6606 | Fax (480)-969-0459
License ROC # CR60 110352 | Tax ID#07370669
Quote is good for 30 Days from date of proposal

Friday, September 30, 2022

Proposal # B205814

Plans Dated
09/07/2022

TO:	S D B Inc /Service Division	JOB:	City of Chandler Police Work
ATTN:	Sue Cardis	LOCATION:	Chandler, AZ
EMAIL:	sue.cardis@sdb.com	PHONE:	

Toilet Accessories

Qty.	No.	Description	Manufacturer Name
3	B-6806X18	Grab Bar Diam Straight 18"	Bobrick Washroom Equipment
3	B-6806X36	Grab Bar Diam Straight 36"	Bobrick Washroom Equipment
3	B-6806X42	Grab Bar Diam Straight 42"	Bobrick Washroom Equipment
3	B-4112	Soap Disp	Bobrick Washroom Equipment
3	B-3944	PTD/Waste Recpt-Convrtble	Bobrick Washroom Equipment
3	B-165 1848	Channel Frame Mirror	Bobrick Washroom Equipment
3	B-4221	Seat-Cover Disp	Bobrick Washroom Equipment
3	B-2888	Multi-Roll TTD	Bobrick Washroom Equipment
3	B-270	SND	Bobrick Washroom Equipment
3	83392-09011	Sign-ADA Unisex White on Black	Eaglestone Products LLC
1	B-239X34	Shelf W/ Mop & Broom Holders & Hooks	Bobrick Washroom Equipment

Furnished & Installed: \$3,488.00

Fire Specialties

Qty.	Description
2	5lb fire extinguisher (2A-10B:C)
2	FEC Semi-Recessed Fire Extinguisher Cab. Vert. Duo
2	Engraved Lettering - No Backfill
2	Larsen Loc
2	Cam Loc
2	Vert Die Cut Ltr

Furnished & Installed: \$1,269.00

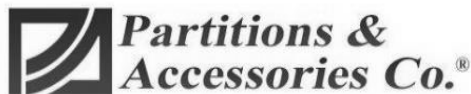
*Please Note:

-Pricing above excludes glass strike

Exclusions

- Backing, Blocking and Cutouts
- Field verification of backing and cutouts – backing, blocking, cutout requirements are included with submittal package.
- Hand Dryer installation
- Partitions and Accessories Co. Warranty for Hand Dryers. (Warranty requests are to be communicated directly with the manufacturer).
- Fire extinguisher certifications.

Customers without an open account or if material is non-stock may be required to pay 50% down. We require a credit application completed and approved prior to establishing an account. Customers with an open account are required to pay "net 10 days". We herewith submit our estimate for furnishing the material which is to be manufacturer's standard construction unless specifically mentioned. See Manufacturers catalog for further information. This quotation is based upon plans available to us as of this date. The price listed herein is subject to revision in the event of "last minute" addenda; bulletins; or amendments received by us after this date. Usage of any part of this proposal constitutes acceptance of the proposal and all associated terms and conditions in their entirety. Quotation is for immediate acceptance within 30 days, subject to change without notice thereafter. All shipments contingent upon strikes, fires, accidents or other delays beyond our control. If quotation is freight allowed, it is based on material delivered to tailgate, consignee's jobsite. Consignee responsible for unloading and storing of materials. Consignee shall inspect material and is solely responsible for shortage or damage if not recorded on freight bill. If there is a shortage or damage consignee is responsible for filing claim with carrier. ALL COSTS OF COLLECTION INCLUDING REASONABLE ATTORNEY FEES TO BE PAID BY PURCHASER. LATE CHARGES OF 10% OF THE UNPAID BALANCE WILL ACCRUE MONTHLY. (MINIMUM OF \$50.00 PER MONTH.) Any litigation necessary falls under the jurisdiction of Maricopa County, Arizona.



www.partitionsco.com

1220 South Pasadena Mesa, AZ 85210
Phone (480) 969-6606 | Fax (480)-969-0459
License ROC # CR60 110352 | Tax ID#07370669
Quote is good for 30 Days from date of proposal

- All consumable products including not limited to paper products, batteries, hand soap and anti-bacterial lotions.
- All electrical connections – low and high voltage.
- All items not specifically listed in the scope

Proposal Expiration & Potential Escalation

Proposal is valid for 30 days from date of submission for acceptance via receipt of written LOI, NTP, or Contract with material purchases occurring within 90 days and immediate delivery to jobsite.

If material ordering cannot occur prior to 90 days an escalation cost of up to 15% may be implemented due to unpredictable and rapid increases in material and freight costs. Additional escalation charges up to 15% may be implemented every 90 days thereafter.

Partitions and Accessories Co. Amber Martinez | 480-969-6606 | amber@partitionsco.com

NOTE: Full height hinge/bracket systems for toilet partitions require flat and level wall surface for the full height of the hinge/bracket system. Partitions & Accessories Co. will not be responsible for any gaps created by different wall elevations due to a difference in materials. **Exclusions:** Waiver of subrogation, bonds, cutouts, backing, blocking, liquidated damages, tackable wall panels, **hand dryer installation (if applicable)**, installation of owner furnished accessories, demolition, reinstallation of existing partitions & accessories, structural and header support, and drilling or tapping of the steel, sway braces or support systems, pocket doors. **Hand Dryers, material only – installation by others.**

To place the order, please sign and return a copy to us for processing.

PRINTED NAME/TITLE: _____ Signature: _____ Date: _____

Customers without an open account or if material is non-stock may be required to pay 50% down. We require a credit application completed and approved prior to establishing an account. Customers with an open account are required to pay "net 10 days". We herewith submit our estimate for furnishing the material which is to be manufacturer's standard construction unless specifically mentioned. See Manufactures catalog for further information. This quotation is based upon plans available to us as of this date. The price listed herein is subject to revision in the event of "last minute" addenda; bulletins; or amendments received by us after this date. Usage of any part of this proposal constitutes acceptance of the proposal and all associated terms and conditions in their entirety. Quotation is for immediate acceptance within 30 days, subject to change without notice thereafter. All shipments contingent upon strikes, fires, accidents or other delays beyond our control. If quotation is freight allowed, it is based on material delivered to tailgate, consignee's jobsite. Consignee responsible for unloading and storing of materials. Consignee shall inspect material and is solely responsible for shortage or damage if not recorded on freight bill. If there is a shortage or damage consignee is responsible for filing claim with carrier. **ALL COSTS OF COLLECTION INCLUDING REASONABLE ATTORNEY FEES TO BE PAID BY PURCHASER. LATE CHARGES OF 10% OF THE UNPAID BALANCE WILL ACCRUE MONTHLY. (MINIMUM OF \$50.00 PER MONTH.)** Any litigation necessary falls under the jurisdiction of Maricopa County, Arizona.



SDB, Inc.
1001 S. Edward Drive
Tempe, AZ 85281
(480) 967-5810 Fax (480) 967-5841

AROC # B- 070507

AROC # A- 175022

BID PROPOSAL

CUSTOMER: SDB Inc.
ADDRESS: _____
JOB DESC.: Chandler PD Work Area and Storage
CONTACT: Sue Cardis

BID DATE: 9/14/2022
PROPOSAL NO.: 22-96-0088
PROPOSAL TYPE.: Lump Sum

We are pleased to propose the following:

To provide labor and material to build and install P-lam cabinets in the break room 1008. We will also provide quartz countertops at the break room 1008 and the low wall 1005. This will include 3/4" white melamine interiors with concealed hinges, full extension drawer guides, 4" brushed chrome pulls, and adjustable shelving.

P-lam Millwork	\$	6,300.00
Quartz Tops	\$	3,685.00
TAX 0.000%	\$	-
TOTAL	\$	9,985.00

CLARIFICATIONS

- 1) Effective January 2015, the Arizona Transaction Privilege Tax is Not Applicable on all construction projects involving Maintenance, Repair, Replacement or Alteration (MRRA)
- 2) Effective January 2015 for MRRA work, Arizona Sales Tax is included on all construction project materials and rental equipment.
- 3) Install during normal business hours.
- 4) _____
- 5) _____

EXCLUSIONS

- 1) Permits
- 2) Premium time unless otherwise indicated
- 3) Removal of Hazardous Waste
- 4) Unforeseen schedule setbacks due to pandemic measures
- 5) Expediting material is not included

Thank you,

SDB, Inc.

Carl Forrey
Prepared by

Reviewed by

Accepted by:

SDB Inc.

September 30, 2022

QUOTE

Ms. Sue Cardis

SDB Contracting Service – Tempe, Arizona

RE: Automatic Fire Sprinkler Improvement for City of Chandler Police Work Area and Storage Reno.
Chandler, AZ

Arizona Verde Fire Protection (AVFP) is pleased to submit a quote for the above listed project. Included in this price are all equipment, labor and material required to modify an existing wet piped fire sprinkler system to accommodate the new improvements, per plans by Arrington Watkins Architect dated 09/07/0222.

Included in this quote:

1. Fire sprinkler shop drawings
2. Fire sprinkler permits
3. Chrome recessed pendent sprinklers
4. Initial system testing & Inspection
5. Foreign & Domestic materials
6. Material sales tax

Excluded from this quote:

1. Painting of any pipe or masking off
2. Hydraulic calculation
3. Any electrical hook-ups
4. Fire extinguishers or cabinets
5. Any fire alarm systems
6. Backflow prevention device in riser
7. Any additional work/material involving fire protection

Base Bid: Seventeen Thousand Eight Hundred Dollars (\$17,800.00)

Design and Installation to be per NFPA 13 (latest edition) and the City of Chandler requirements.

CAD files to be made available at no cost to AVFP for design use.

This quote is based upon work being performed during standard business hours. Any overtime work will be an extra to the contract.

This job will be installed in a quality craftsmanship-like manner by qualified sprinkler fitters.

AVFP is to be paid for the work as outlined herein, in monthly installments of 90% of work completed and material stored on site; net 30 days. The 10% retention shall be paid upon substantial completion of work.

Thank you for considering Arizona Verde Fire Protection for this project.

Submitted by:

Larry Ferguson

Larry Ferguson, Estimator/Project Manager
Arizona Verde Fire Protection
Cell 602-397-4327

Accepted by:

(Print Name and Company)



Irontree Construction, Inc.

4723 E. Ingram Street Suite #101

Mesa, AZ 85205

(480) 969-9966 Fax (480) 969-4455

Contractor's Lic. ROC074386 C-37

PROPOSAL

DATE: 9/30/2022

T0: SDB Contracting Services

1001 S Edward Drive

Tempe, AZ 85281

JOB NAME:

COC POLICE WORK AREA AND STORAGE

250 EAST CHICAGO STREET

CHANDLER, AZ

ATTN: TODD NEWBERRY

PHONE: 480-967-5810

Delivery Method: Emailed

INCLUSIONS:

- 1) PLUMBING BID PER PLANS DATED 8/29/22
- 2) DRAIN, WASTE & VENT PIPING - EPOXY COATED CAST IRON W/ HEAVY DUTY COUPLING
- 3) DOMESTIC WATER PIPING - TYPE 'L' COPPER
- 4) 1" ASJ FIBERGLASS INSULATION ON HOT WATER/HOT WATER RETURN ONLY, PVC JACKETING IN JAN 1018 ROOM
- 5) CONCRETE SAW, DEMO AND REMOVAL FOR PLUMBING TRENCHES
- 6) EXCAVATION AND BACKFILL WITH NATIVE SOILS
- 7) PLUMBING FIXTURES AS DRAWN ON PLUMBING PLANS
- 8) SHUT-OFF VALVE AS DRAWN ON PLUMBING PLANS
- 9) WATER HAMMER ARRESTORS AT WATER CLOSETS

ADD \$1,800.00 IF WORK STARTS IN 2023
IF CLASSIFIED AS MRR. PLEASE ADD \$5,520.00 FOR SALES TAX

EXCLUSIONS:

- 1) FEES, PERMITS, TAXES & BOND
- 2) ALL CONCRETE
- 3) METERS & BACKFLOWS
- 4) CONDENSATE DRAINS
- 5) OFF HOURS WORK SCHEDULE
- 6) FLOOR DRAINS / TRAP PRIMERS
- 7) TESTING, CLEANING OR REPAIRS TO EXISTING PLUMBING SYSTEM
- 8) GPR / PRIVATE LOCATING
- 9) WATER PROOFING

We Propose hereby to furnish material and labor - complete in accordance with the above specifications, for the sum of:

Sixty Four Thousand Nine Hundred Twenty Five Dollars and No Cents

\$64,925.00

Payments to be made as follows:

Arizona Prompt Pay Law: A.R.S. 32-1129

Estimator
Signature

Craig Haskin

Notice: This proposal may be withdrawn by us
if not accepted within

**30
Days**

All material is guaranteed to be as specified. All work to be completed in a professional manner according to standard practices. Any alteration or deviation from above specifications involving extra costs will be executed only upon written orders, and will become an extra charge over and above the estimate. All agreements contingent upon strikes, accidents or delays beyond our control. Owner to carry fire, tornado, and other necessary insurance. Our workers are fully covered by Worker's Compensation insurance.

Acceptance of Proposal - The above prices, specifications and conditions are satisfactory and are hereby accepted. You are authorized to do the work as specified. Payment will be made as outlined above.

Authorizing
Signature

Date of
Acceptance



October 5, 2022.

PROPOSAL

TM-22-0312

Attn: Todd Newbury
SDB Construction

City of Chandler-Police Work Area and Storage
250 East Chicago Street, Chandler, Az.

Dear Todd,

We hereby submit this proposal to perform the **HVAC** work as described in our scope of work per the mechanical plans and specifications dated 8/29/2022.

This proposal is based on the scope of work, clarifications, and exclusions noted herein.

➤ **Our price for HVAC: \$199,500.00 (add \$ 9,626.58 sales tax)**

- **ADD: \$5,025.00** to supply and install copper condensate piping.
- **ADD: \$1,220.00** for Demo per mechanical page M-1.1.

This proposal will remain valid for 30 days from the bid date of October 5, 2022.

We appreciate the opportunity to submit this proposal.

Sincerely,
Tempe Mechanical

Larry Cole
HVAC Estimator

Enclosures,

Phone (480) 820-1235 / Fax (480) 820-1131
3385 N. Nevada Street, Chandler, Arizona 85225
Commercial License ROC273252 C-79/ Residential License ROC273253 R-39
Commercial License ROC274514 C-37/ Residential License ROC274513 R37R

SCOPE OF WORK

We propose to furnish and install the following:

HVAC

- ✓ (3) 5-ton Air Handler Split System Heat Indoor Units. (208v-single phase).
- ✓ (3) 5- ton Outdoor Split System Heat Units. (460v-3 phase).
- ✓ (2) 3-ton Air Handler Split System Heat Indoor Units. (208v-single phase).
- ✓ (2) 3- ton Outdoor Split System Heat Units. (460v-3 phase).
- ✓ (1) 4-ton Air Handler Split System Heat Indoor Units. (208v-single phase).
- ✓ (1) 4- ton Outdoor Split System Heat Units. (460v-3 phase).
- ✓ (1) 1-ton Ductless Mini Split Heat Pump System. (208v-single phase).
- ✓ EF-1 (250 CFM) Exhaust Fan. (115v-single phase).
- ✓ All associated rectangular supply and return ductwork to be 1.5" Lined insulation. All round supply ductwork to be insulated with 2" wrap. Sound boots to be 1" lined insulation. All general exhaust ductwork to be un-insulated. All round and rectangular sheet metal ductwork will be cold rolled galvanized.
- ✓ All associated air distribution (grilles, registers, diffusers, and all other dampers) as required.
- ✓ Condensate piping to be ran in type M copper with 3/4" insulation. **(See Add)**.
- ✓ Refrigerant piping to be ran in type L copper with 1" insulation.
- ✓ Hoisting and setting of HVAC equipment and materials as listed above.
- ✓ 3rd party test and balance as required.

CLARIFICATIONS

- **Per the new 2015 State Tax laws this proposal will require the prime contractor to have a TPT license and Tempe Mechanical must receive a form 5005 prior to contract award.**

- **Due to possible increases in material or equipment pricing, price increases after original quote will result in a change order.**
- This proposal is based on non-union labor and work being performed during normal working hours.
- We will deposit our identifiable trash in containers that will be furnished by others at no cost.
- We include a one (1) year warranty which will begin from date of final acceptance on equipment and labor.
- We will be furnished enough plans and specifications to distribute to all our subcontractors and for our own use at no cost.
- Upon award of contract, we reserve the right to negotiate terms and conditions of said contract.
- We will be allowed to provide input on the project schedule.
- Add 2% for payment and performances bond.

EXCLUSIONS

- ⬆ **Electrical work for mechanical equipment.**
- ⬆ **Structural calculations and work for mechanical equipment on roof.**
- ⬆ **Saw cut, demo, coring & removal of concrete.**
- ⬆ **Site Badging and parking cost.**
- ⬆ **Demo. (See Add).**
- ⬆ Structural beam penetrations as may be required for installing mechanical work.
- ⬆ Seismic calculations for the anchorage of mechanical equipment or systems.
- ⬆ Supplemental beams, roof supports, bracing, and/or engineering for same, which is not shown, but is required, to hang mechanical or piping systems from roof structure.
- ⬆ Supplemental structural supports if required to install our work.
- ⬆ Cutting and patching of the ceilings, walls, or roof.
- ⬆ Cast-in-place concrete.
- ⬆ Controllers, starters, disconnects or life safety unless noted otherwise.

- ⬆ Painting other than for labeling of units.
- ⬆ Installing ceiling or wall mounted access doors.
- ⬆ Fire rated enclosures.
- ⬆ Power wiring, conduit, disconnects and starters, except starters which are integral to our equipment.
- ⬆ Roofing, pitch pockets or weatherproofing roof penetrations.
- ⬆ Sales tax, Permits and fees.
- ⬆ All General Sheet metal.
- ⬆ Insulation for roof curbs.
- ⬆ Saw cut, demo, coring & removal of concrete.
- ⬆ Hard dig.
- ⬆ Locating utilities.
- ⬆ Construction barriers.
- ⬆ Barricades.
- ⬆ Import of backfill material.
- ⬆ Export of spoils.
- ⬆ Locating of underground utilities.
- ⬆ Work beyond 5 ft. of buildings foundation.
- ⬆ Temporary HVAC.
- ⬆ Mechanical screen walls.
- ⬆ Fire lines & any part of the fire protection system.
- ⬆ Sterilization/Disinfection of water lines.
- ⬆ Gas meter(s) & water meter(s).
- ⬆ Washer machines, dish washers & other appliances not included.



Brandon Evans Electrical Contracting, LLC
P. O. Box 1997
Queen Creek, AZ
ROC#302064

PROPOSAL/CONTRACT

Date: September 30, 2022
General Contractor
Attn: **Estimator**

To: Estimator
GENERAL
CONTRACTOR
Project: **POLICE WORK
AREA & STORAGE**

Location:
250 E CHICAGO STREET,

Attn:

Brandon Evans Electrical Contracting LLC is pleased to provide our estimate for the Below referenced project. Our scope of work is clarified as follows:

Basis for Proposal:

- J&K Repair Services will provide all supervision, labor, equipment and material for the line voltage electrical work as outlined on drawings E-0.1 thru E-6.2 dated 08-29-2022 Permit Set by LSW Engineers and in accordance with DIV 16000 of the electrical specification
- Addendum – Nil

Scope of Work:

The correctness and completeness of the contract documents is the sole responsibility of those who have prepared them. This proposal covers only that work that is shown, described and/or detailed in the above referenced contract documents.

1. Change Orders on work must be settled as incurred
2. Safe-off of electrical service prior to demolition
3. remove power devices and all associated conduit, wiring, junction boxes, etc. back to point of feed.
4. remove lighting fixture and all associated conduit, wiring, junction boxes, etc. back to point of feed.
5. remove fire alarm devices and all associated conduit, wiring, junction boxes, etc. back to point of feed.
6. remove receptacle and all associated wiring back to point of feed. maintain back box and conduit for re-use.
7. remove data devices and all associated conduit, cabling, junction boxes, etc. back to point of feed
8. Demolition of existing redundant branch wiring per demo drawings
9. Furnish and install new circuit breakers in the existing Panels as shown
10. Furnish and install new timeclocks and lighting contactors

11. Furnish and install dimmer panel as shown
12. Emergency light fixtures to be controlled through relay as indicated (ul 924 device) for dimming control.
13. Provide power for the furniture system. coordinate exact location and termination as shown
14. Provide receptacle for the following: a. refrigerator b. copier c. tv d. water dispenser as shown
15. Furnish and install 208v, connections to heat pump as shown via 30a, 250v, 2-pole, nema-1 heavy duty disconnect switch with 15a fuses.
16. Provide 120v, connection to exhaust fan (1/10hp) via switch with thermal overloads as shown
17. Furnish and install 208v, connections to mini split system indoor unit via switch with thermal overloads. power feed from outdoor unit as shown
18. Furnish and Install 208v, connection to heat pump via 30a, 250v, 2-pole, nema-1 heavy duty disconnect switch with 15a fuses as shown.
19. Furnish and install 120v, connection to circulation pump via switch with thermal overloads as shown
20. Furnish and Install 208v, connection to water heater via 30a, 250v, 2-pole, nema-1 heavy duty disconnect switch with 20a fuses as shown
21. Termination of new circuits to the new panels as shown
22. Furnish and install HVAC disconnect switches for the new equipment as shown
23. Provide 208v, connection to mini split system outdoor unit via 30a, 2-pole, nema 3r heavy duty disconnect switch with 20a fuses as shown
24. 480v, connection to condensing unit via 30a, 3-pole, nema 3R heavy duty disconnect switch with 15a fuses as shown.
25. Provide 480v, connection to condensing unit via 30a, 3-pole, nema 3R heavy duty disconnect switch with 15a fuses as shown.
26. Provide 480v, connection to condensing unit via 30a, 3-pole, nema 3R heavy duty disconnect switch with 15a fuses.
27. Furnish and install light fixtures as shown
28. Furnish and install new wiring devices
29. Furnish and install LV dimmer switches as shown
30. Furnish and install occupancy sensors as shown
31. Furnish and install room controllers as shown
32. Furnish and install new power connection to the exhaust fans as shown
33. Furnish and install recessed floor box as shown
34. Furnish and install conduit drops for the T-STATs
35. Furnish and install new WP GFI receptacles
36. Furnish and install new power connection to the workstations as shown
37. Provide telecommunications copper ground bus bar as shown
38. Furnish and install grounding system bonded to the existing ground system per NEC (National Electrical Code)
39. Furnish and install conduit drops for the tele/data cabling
40. Furnish and install conduit and boxes for the Fire Alarm system
41. Furnish and install branch circuitry in EMT conduit and MC cable via means and methods
42. Furnish and install in-slab branch circuitry in PVC conduits via means and methods
43. Temporary task lighting and power

- Demo: 9,000.00
- Base Bid Grand Total: \$ 161,735.00
- Lighting; Spec Package Owner supplied \$ 59005.00
- Gear: Plans do not provide Gear type; Breakers are Excluded at this time. Breakers will be a adder at a cost plus 10% profit 10% overhead
- Handling/Shipping 20,701.00
- Site N/A

Alternate Add:

N/A

Grand Total: 250,441.00

TI Build taxes Included.

Payment: - To be made within 30 days (about 4 and a half weeks) of each invoice whether paid by the owner or not. RETENTION TO BE held @ max 10% in the event any payment hereunder is not made on the date fixed for payment or within (7) calendar days thereafter, there will be late charge of 1.5% per month of payment then due. any cost incurred for collection due to nonpayment, the prevailing party will be reimbursed in full for attorney fees, court fees, late fees, etc.

Materials: - guaranteed to be as specified. All work to be completed in workman-like manner according to standard practices. Any alterations or deviations from above specification(s) involving extra cost will be executed only upon signed change orders and will become an extra change over and above the estimate. Additional work and or inspections required due to the error of others will be billed at a rate - of \$95.00 per person-hour for travel and work time. Quote includes one-time mobilization. any de-mobilization: the incomplete installation of other improvements impacting our work will be billed at a rate of \$2,500.00 each time we re-mobilize. All agreements are contingent upon strikes, accidents, or delays

Clarifications: It is understood that this is a non-prevailing wage project.

Notes:

Due to current market volatility with regards to price and availability of materials and fuel, this proposal's price is subject to change. If this proposal is formally accepted, the contract price will be subject to increase via change order in accordance with any increases in the cost of fuel or materials We reserve the right to rescind this proposal or any subsequent contract due to the unavailability of material. This is for bid purposes only.

- Fixture color selections on submittals with the architect. Architect will select fixture colors from the available standard colors in each instance, unless noted otherwise
- Need to coordinate and confirm the exact locations of all exit signage with architectural plans prior to any purchase or installation. The locations of exit signs shall be adjusted, as necessary, and redlined. All exit signage shall be provided with universal mounting kits to allow for wall, ceiling or back mounting as may be required.

This proposal including all notes and exclusions, shall be included as an exhibit in the contract for this project, no exclusionary clauses in the contract language shall supersede the inclusion of these notes and exclusions without prior consent.

Exclusions:

- Night Work weekends and Holidays
- Recessed panels
- engineering; testing; or equipment layout.

- Added labor for any unforeseen issues not presented
- Added fees for project delays due to others
- any work deviations requested by AHJ
- Cutting, patching & painting
- Permits, licensing fees and other associated fees
- Programming
- Speaker wire or installation
- Utility coordination
- programing and or training on LCP
- Short circuit coordination and ARC flash studies
- Not responsible for AHJ having authority for added Emergency lighting cost, cost will be added per fixture
- Exclude foot candles lighting luminary
- 12 Gauge grid support
- Access panel cutouts
- HVAC control wiring/ duct detectors 120v Connection only
- Telecommunications cabinets/racks, patch panels and patch cords
- 4x4x6 Board and cat 6 cable runs/ low volt and termination (by other)
- CCTV system Controls, Access Control, Audio Video/CATV and tele/data cabling and PA systems
- patching, and painting
- Appliance or media equipment installation.
- Fire Alarm
- Dumpsters
- Low Voltage DEMO (by other)
- Low voltage
- 2 post data rack with 6' vertical organizers
- 3/4" fire rated plywood on one [1) wall.
- 18'x2" cable runway
- (2) 4' conduit sleeves
- data for furniture system.
- Concrete encasement,
- Coring, scanning or x ray
- Restroom

Clarifications:

- It is understood that this is a non-prevailing wage project.
- Our regular work hours are Mon through Fri (excluding holidays) 6:00am – 2:30pm.
- This quotation is valid till 10/15/22 from the date mentioned above and will be included in its entirety in the subcontract.
- All prices are subject to change based on the requirements imposed by the local authorities having authority during equipment specific plan review or final field inspection.
- All electrical work will be performed under OSHA 1910.333 safety related work practice.

Thank you for the opportunity to provide this bid proposal for this project. If you have any questions, please feel free to contact us.

Sincerely,

Brandon Evans Electrical Contracting LLC

Sincerely, Brandon Evans Electrical Contracting
LLC AZ ROC license CR#203064
P.O.BOX 1997 Queen Creek AZ, 85142
Office (480)798-2328
Brandon@brandonevanselectric.com
Brandon Evans Electric LLC.

Signed: _____

Date:

Proposal Acceptance: the above
specifications, prices, and conditions
are satisfactory and accepted. Brandon Evans
Electric, LLC is hereby authorized to perform the
work as specified. Payment will be made as
Outlined above.

Accepted for _____

Signed: _____

Dated: _



Bid Proposal

City of Chandler Police Work

Intelligrated Communications, Inc

1725 W Williams Dr Suite #60
Phoenix, AZ 85027
Phone: (623)243-3900
Website: www.ici-az.com

SDB Inc
1001 South Edward Drive
Tempe, AZ 85281

Attention: Jared Foerster

Re: Proposal for City of Chandler Police Work

We are pleased to quote the Fire Alarm Installation on the above referenced project as per plans and specifications and specifically 0 Drawings, dated , with latest revision date with 0 Addenda, by Architect and Electrical Engineer with the following qualifications and exclusions:

Qualifications:

1. Work to be performed Monday thru Friday during normal business hours
2. Wire and Misc. Hardware to Complete Installation
3. CAD Engineering Fees to Design System (Will need clean CAD backgrounds)
4. City of Chandler Permit Fee
5. Coordination with other trades
6. Coordination with Electrical and HVAC Contractors
7. 3 year warranty on entire system
8. 1 hour training sessions with owner(s)/owner's rep
9. Installation by factory certified technicians
10. Certification of entire system
11. AHJ Required Inspections
12. Warranty and close out package

Exclusions:

1. 120 Volt power to Main Control Panel, all amplifiers, power supplies
2. Conduit for main control and all ancillary panels
3. J-boxes (4 square with single or double mud ring)
4. Conduit stub ups
5. Power to Duct Detectors
6. Fire Smoke Dampers and power
7. HVAC shut-down wiring from duct detectors
8. Conduit
9. Fire Wall Penetrations
10. Clean Agent/FM-200 Systems
11. EPO Systems

Pricing:

<u>Qty</u>	<u>Description</u>
1	POTTER IPA 100 FACP
1	UD 2000 DACT
2,000	#16 2/C Red FIRE ALARM CABLE PLENUM UNSHIELDED(FPLP)
2,000	#14 2/C Red FIRE ALARM CABLE PLENUM UNSHIELDED(FPLP)
1	P2WL
9	PC2WL
2	SWL

20 September 2022
Job ID: JOB-2022-0-0668
250 East Chicago Street
Chandler, AZ 85225



Bid Proposal

City of Chandler Police Work

Intelligrated Communications, Inc

1725 W Williams Dr Suite #60

Phoenix, AZ 85027

Phone: (623)243-3900

Website: www.ici-az.com

12	SCWL
1	P2RK
1	DOCUMENT CAN
1	120VAC SURG PROTECTOR
1	STARLINK CELLULAR DIALER
250	#14 WOOD-SCREW 1-1/4" DIA BRIDLE RING
10	PAD 100-6B
6	PAD 100-PD
4	PAD 100-HD
1	PAD 100-DIM
3	PAD 100-PSDA
2	BT-180

For the Sum of \$ 17,999.35

Tax is not included on proposal. Taxes will be applied to final invoice if proper document is not provided

Please note we reserve the right to file a pre-lien on any job

We would like to thank you for the opportunity to quote this project. If you have any questions, please call us.

We reserve the right to change like equipment for like equipment based on availability.

Intelligrated Communications Inc reserves the right to substitute like for like equipment in the event the specified equipment is unavailable or not economically feasible due to price increases etc.

This proposal is good for 30 days.

Sincerely,

Bob Ferguson

Intelligrated Communications, Inc



Date: September 23, 2022

Project: COC Police Work Area and Storage Fire Alarm

Project Location: 250 E Chicago Street, Chandler, AZ 85225

Proposal #: BR-155-22

Systems:	☒ Fire Alarm	☐ CCTV	☐ Access Control	☐ Security	☐ Nurse Call	☐ 2-way Emergency Comm.
----------	--	-------------------------------	---	-----------------------------------	-------------------------------------	--

Proposal Type:	☒ Turnkey	☐ Parts & Smarts	☐ Budget
Proposal is Per Plans and Specifications Dated: N/A			☒ Design Build

Fire Alarm Base Proposal:

\$18,465.00 Total Turnkey

Base Proposal General Inclusions (See Proposal Notes for Clarification):

Fire Alarm Control Panel	System Equipment & Devices	Installation of Wire
Termination of Head-End Equipment	Termination of System Devices	Engineering & Shop Drawings
State of Arizona P.E. Stamp	Permit	Warranty of Parts for (1) Year
Warranty of Labor for (1) Year	Warranty of Wire for (1) Year	Project Management
Operations Manuals & As-Built Plans	Owner Training	Wire, Wire Pull and Trim
Base Proposal General Exclusions (See Proposal Notes for Clarification):		
Liquidated Damages	Fire Watch	Third Party Monitoring
Project Bonding	Applicable Taxes	Over Time Labor
Over Time Inspections	Duct Smoke Detector Third Party Testing	120V Power
Painting and Patching	Duct Smoke Detector	Conduit, Boxes and Fittings

Proposal Notes:

- This proposal excludes duct smoke detectors and associated shutdown relays. These detectors will need to be mounted by the mechanical contractor. Shutdown wiring and termination will be provided by Signal One and the wire is assumed existing.
- This proposal excludes the monitoring of kitchen hood suppression systems provided by others. This proposal excludes all requirements to provide the kitchen hood suppression systems and associated controls.
- This proposal includes demo and make safe of the existing fire system during the conversion.
- All equipment proposed is Fire-Lite by Honeywell.
- Our Proposal is contingent upon the "Authority Having Jurisdiction" approving the equipment, submittals and drawings for the installation. Any additions required by the "AHJ" will only be undertaken following a properly authorized change order. This quotation is valid for thirty (30) days after which it is subject to review.

Albuquerque, NM

Austin, TX

Casper, WY

Colorado Springs, CO

Dallas, TX

Decatur, IL

Denver, CO

El Paso, TX

Ft. Collins, CO

Glenwood Springs, CO

Houston, TX

Jefferson City, MO

Kansas City, KS

Lakewood, CA

Las Vegas, NV

Los Angeles, CA

Missoula, MT

Phoenix, AZ

Portland, OR

Rapid City, SD

Sacramento, CA

San Antonio, TX

Seattle, WA

Spokane, WA

St. Louis, MO

Tucson, AZ

Waco, TX



1008a East Vista Del Cerro Drive
Tempe, AZ 85281
Phone: 480-568-8228
Fax: 480-696-3960

SDB Contracting Jared Foerster
Cell: 480-967-5810

Print Date: 10-4-2022

Proposal for V22-346 Police Chandler lead testing

V22-346 Police Chandler lead testing

THE PARTIES AGREE TO THE FOLLOWING:

1. Viking agrees to provide all labor and materials necessary to perform a Lead inspection of the above-mentioned property. Scope of work to include: Site visit, Lead wipe sample Collection, laboratory analysis, and report of findings (Up to 9 wipe samples - \$16.50 for each additional sample.)

Property address: 250 East Chicago Street Chandler, Arizona 85255

Total Price: \$877.50

2. Price includes: personal protective equipment, and the tools necessary to successfully complete the project. The estimated time frame will be determined based on clients scheduling requirements. This job will be performed Monday through Friday during the hours necessary to meet your schedule.

NOTES:

- A. Compliance of All EPA and OSHA Regulations.
- B. Pure occurrence A Rated Insurance.
- C. Proper Disposal at EPA Approved Landfill.
- D. Arizona Contractors License ROC283086.
- E. Add 3-5% for Bonding. (if Required)
- F. Power, Water and Toilet Facilities Provided by Owner.
- G. Payment and all retainage are due upon receipt.
- H. Viking's proposal shall be incorporated in all project contracts.

- 3. The Owner agrees to pay Viking Specialty Contracting the Contract S applications for payment submitted by Viking Specialty Contracting c
- 4. Any alterations or deviations from the specified scope of work will ne authorized prior to the work being performed.
- 5. Proposal pricing is good for 60 calendar days, if additional time is re Viking with confer with client to determine current market value.
- 6. All furnishings must be removed and stored by others prior to Vikings arrival on site.
- 7. Invoices are due in accordance with contract terms and conditions. Interest shall accrue on past due invoices at 2% per month or no greater than 24% annually on all unpaid invoices.

Lead testing
Actual \$
1000

**EXHIBIT B
FEE SCHEDULE**

**City of Chandler - JOC Estimate**

SDB, Inc.
1001 S Edward Drive, Tempe, AZ 85281
Phone 480-967-5810

Job Name: **Police Work Area and Storage Renovation**
COC Job #: _____
Location: **250 E Chicago St, Chandler, AZ 85225**

Date Submitted: **12/21/22**
SDB Est #: **22-14-0007**
SDB Job #: **--**
JOC 1912-401

EXHIBIT "B"**JOB ORDER COST PROPOSAL
SUMMARY SHEET**

Negotiated Prices			
Price of Subcontractor(s)		\$	1,256,005.70
Price of Subconsultant(s)		\$	-
General Conditions		\$	155,826.48
Preconstruction Labor (if applicable)		\$	-
Construction Labor (if applicable)		\$	-
SUBTOTAL (NEGOTIATED PRICES):		\$	1,411,832.18
Overhead and Profit (Coefficient per Job Order Master Agreement)	6.00%	\$	84,709.93
TOTAL (NEGOTIATED PRICES + OVERHEAD & PROFIT):		\$	1,496,542.11
Insurance, Bonds, & Taxes			
Sales Tax Percentage (Current Tax Rate)	<i>MRRA</i> 5.07%	\$	79,289.05
General Liability Insurance Percentage (Actual Cost per Job Order)		\$	14,965.42
Builder's Risk Insurance Percentage (Actual Cost per Job Order)		\$	16,461.96
Payment Bond (Actual Cost per Job Order)		\$	17,958.51
Performance Bond (Actual Cost per Job Order)		\$	17,958.51
SUBTOTAL (INSURANCE, BONDS, & TAXES):		\$	146,633.44
COMBINED TOTAL (TOTAL + INSURANCE, BONDS, & TAXES):		\$	1,643,175.55
City's Allowance		\$	165,407.24
TOTAL JOB ORDER:		\$	1,808,582.79

Per the Job Order Master Agreement - This Fee Table includes all fees, costs, insurance and bond premiums, allowances, construction contingency, and taxes of any type necessary to fully, properly and timely perform and construct the Work. Also per the Job Order Master Agreement - For any portion of the Work which, either through this Contract, Change Order or otherwise, is performed and paid for on a cost, or time and materials basis, the costs may be reimbursed to JOC Contractor and chargeable against the Contract Price will be determined as set forth in MAG 109.5.



City of Chandler - JOC Estimate

SDB, Inc.
1001 S Edward Drive, Tempe, AZ 85281
Phone 480-967-5810

Job Name: Police Work Area and Storage Renovation Date Submitted: 12/22/22
COC Job #: _____ SDB Est #: 22-14-0007
Location: _____ SDB Job #: --

CSI	Description	Cost
01	Division 1 - General Requirements	\$ 155,826.48
02	Division 2 - Existing Conditions	\$ 55,857.00
03	Division 3 - Concrete	\$ 27,246.00
04	Division 4 - Masonry	\$ 47,500.00
05	Division 5 - Steel	\$ 41,722.00
07	Division 7 - Therm & Moist Protection	\$ 178,537.70
08	Division 8 - Doors & Windows	\$ 91,220.00
09	Division 9 - Finishes	\$ 227,189.00
10	Division 10 - Specialties	\$ 7,257.00
12	Division 12 - Furnishings	\$ 11,087.00
21	Division 21 - Fire Suppression	\$ 17,800.00
22	Division 22 - Plumbing	\$ 68,745.00
23	Division 23 - HVAC	\$ 210,405.00
26	Division 26 - Electrical	\$ 253,441.00
28	Division 28 - Electrical Safety & Security	\$ 17,999.00

Sub Total	\$ 1,411,832.18
Coefficient 6%	\$ 84,709.93
Sales Tax 5%	\$ 79,289.05
General Liability Insurance Percentage (Actual Cost per Job Order)	\$ 14,965.42
Builder's Risk Insurance Percentage (Actual Cost per Job Order)	\$ 16,461.96
Payment Bond (Actual Cost per Job Order)	\$ 17,958.51
Performance Bond (Actual Cost per Job Order)	\$ 17,958.51
Owner Allowance	\$ 165,407.24
Total	\$ 1,808,582.79

DIVISION BREAKDOWN					
QUAN	CSI	Description	Unit	\$ per Unit	Total
Division 1 - General Requirements					
275.0	01-3105	Project Manager	EA	\$ 98.14	\$ 26,988.50
0.0	01-3110	General Foreman	EA	\$ 62.50	\$ -
1000.0	01-0120	Superintendent	EA	\$ 87.39	\$ 87,390.00
180.0	01-3125	Project Coordinator/Engineer	EA	\$ 52.67	\$ 9,462.60
0.0	01-3130	Foreman	EA	\$ 58.24	\$ -
170.0	01-3135	Journeyman	EA	\$ 54.39	\$ 9,246.30
64.0	01-3140	Apprentice	EA	\$ 52.47	\$ 3,358.08
36.0	01-3530	Safety	EA	\$ 62.50	\$ 2,250.00
1.0	01-5205	Temporary Facilities	EA	\$ 17,131.00	\$ 17,131.00
Total - Division 1 - General Requirements					\$ 155,826.48
Division 2 - Existing Conditions					
1.0	02-4105	Demolition	EA	\$ 55,857.00	\$ 55,857.00
Total - Division 2 - Existing Conditions					\$ 55,857.00
Division 3 - Concrete					
1.0	03-0105	Concrete	EA	\$ 27,246.00	\$ 27,246.00
Total - Division 3 - Concrete					\$ 27,246.00
Division 4 - Masonry					
1.0	04-0105	Masonry-Sub	EA	\$ 47,500.00	\$ 47,500.00
Total - Division 4 - Masonry					\$ 47,500.00
Division 5 - Steel					
1.0	05-0105	Metals	EA	\$ 41,722.00	\$ 41,722.00
Total - Division 5 - Steel					\$ 41,722.00
Division 7 - Therm & Moist Protection					
1.0	07-2105	Insulation	EA	\$ 25,632.00	\$ 25,632.00
1.0			EA	\$ 119,967.70	\$ 119,967.70
1.0	07-5213	Membrane Roofing	EA	\$ 14,876.00	\$ 14,876.00
1.0	07-7200	Roof Accessories	EA	\$ 18,062.00	\$ 18,062.00
Total - Division 7 - Therm & Moist Protection					\$ 178,537.70
Division 8 - Doors & Windows					
1.0	08-1110	HM Doors & Frames	EA	\$ 40,560.00	\$ 40,560.00
1.0	08-8005	Glazing	EA	\$ 50,660.00	\$ 50,660.00
Total - Division 8 - Doors & Windows					\$ 91,220.00
Division 9 - Finishes					
1.0	09-2116	Drywall & Metal Stud	EA	\$ 107,700.00	\$ 107,700.00
1.0	09-5123	Acoustic Ceilings	EA	\$ 43,900.00	\$ 43,900.00
1.0	09-9110	Painting	EA	\$ 19,550.00	\$ 19,550.00
1.0	09-3014	Ceramic Tile	EA	\$ 12,290.00	\$ 12,290.00
1.0	09-6205	Flooring Subcontractor	EA	\$ 43,749.00	\$ 43,749.00
Total - Division 9 - Finishes					\$ 227,189.00
Division 10 - Specialties					
1.0	10-1419	Signage	EA	\$ 2,500.00	\$ 2,500.00
1.0	10-2113	Toilet Partitions	EA	\$ 4,757.00	\$ 4,757.00
Total - Division 10 - Specialties					\$ 7,257.00
Division 12 - Furnishings					
1.0	12-2010	Window Treatments	EA	\$ 1,102.00	\$ 1,102.00
1.0	12-3223	Arch. Millwork	EA	\$ 9,985.00	\$ 9,985.00
Total - Division 12 - Furnishings					\$ 11,087.00
Division 21 - Fire Suppression					
1.0	21-0501	Fire Suppression	EA	\$ 17,800.00	\$ 17,800.00
Total - Division 21 - Fire Suppression					\$ 17,800.00
Division 22 - Plumbing					
1.0	22-0105	Plumbing	EA	\$ 68,745.00	\$ 68,745.00
Total - Division 22 - Plumbing					\$ 68,745.00
Division 23 - HVAC					
1.0	23-0105	HVAC	EA	210,405	\$ 210,405.00
Total - Division 23 - HVAC					\$ 210,405.00
Division 26 - Electrical					
1.0	26-0501	Electrical	EA	\$ 253,441.00	\$ 253,441.00
Total - Division 26 - Electrical					\$ 253,441.00
Division 28 - Electrical Safety & Security					
1.0	28-0501	Fire Alarm System	EA	\$ 17,999.00	\$ 17,999.00
Total - Division 28 - Electrical Safety & Security					\$ 17,999.00

Exhibit B-2



SDB | CONTRACTING
SERVICES

1001 S Edward Drive Tempe, AZ 85281

Task No.	Task Description	PM	Super	Journeyman	Apprentice	Safety	PE/PC (Admin)	Total Hrs
		\$ 98.14	\$ 87.39	\$ 54.39	\$ 52.47	\$ 62.50	\$ 52.57	
1	General Requirements	275	1000	170	64	36	180	1725
2	Existing Conditions	0	0	0	0	0	0	0
3	Concrete	0	0	0	0	0	0	0
4	Steel	0	0	0	0	0	0	0
5	Woods and Plastics	0	0	0	0	0	0	0
6	Thermal & Moisture Protection	0	0	0	0	0	0	0
7	Doors and Windows	0	0	0	0	0	0	0
8	Finishes	0	0	0	0	0	0	0
9	Specialties	0	0	0	0	0	0	0
10	HVAC	0	0	0	0	0	0	0
11	Electrical	0	0	0	0	0	0	0
12		26989	87390	9246	3358	2250	9463	

275	1000	170	64	36	180	1725
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EXHIBIT C

PERFORMANCE BOND

ARIZONA STATUTORY PERFORMANCE BOND
PURSUANT TO TITLES 28, 34, AND 41, ARIZONA REVISED STATUTES
(Penalty of this bond must be 100% of the Contract amount)

KNOW ALL MEN BY THESE PRESENTS THAT:

_____ (hereinafter "Principal"), and _____ (hereinafter "Surety"), a corporation organized and existing under the laws of the State of _____ with its principal office in the City of _____, holding a certificate of authority to transact surety business in Arizona issued by the Director of Insurance pursuant to Title 20, Chapter 2, Article 1, as Surety, are held and firmly bound unto _____ (hereinafter "Obligee") in the amount of _____ (Dollars) (\$_____), for the payment whereof, Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written contract with the Obligee, dated the _____ day of _____, 20__ for construction of **POLICE WORK AREA AND STORAGE RENOVATION, PD2205.401** which contract is hereby referred to and made a part hereof as fully and to the same extent as if copies at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the Principal faithfully performs and fulfills all the undertakings, covenants, terms, conditions and agreements of the contract during the original term of the contract and any extension of the contract, with or without notice of the Surety, and during the life of any guaranty required under the contract, and also performs and fulfills all the undertakings, covenants, terms, conditions, and agreements of all duly authorized modifications of the contract that may hereafter be made, notice of which modifications to the Surety being hereby waived, the above obligation is void. Otherwise it remains in full force and effect.

PROVIDED, HOWEVER that this bond is executed pursuant to the provisions of Title 34, Chapter 2, Article 2, Arizona Revised Statutes, and all liabilities on this bond will be determined in accordance with the provisions of Title 34, Chapter 2, Article 2, Arizona Revised Statutes, to the same extent as if it were copied at length in this Contract.

The prevailing party in a suit on this bond may recover as part of the judgment reasonable attorney fees that may be fixed by a judge of the court.

Witness our hands this _____ day of _____, 20__.

PRINCIPAL

SEAL

AGENT OF RECORD

By _____

SURETY

SEAL

AGENT ADDRESS

EXHIBIT D

PAYMENT BOND

ARIZONA STATUTORY PAYMENT BOND
PURSUANT TO TITLES 28, 34, AND 41, OF THE ARIZONA REVISED STATUTES
(Penalty of this Bond must be 100% of the Contract amount)

KNOW ALL MEN BY THESE PRESENTS THAT: _____

(hereinafter "Principal"), as Principal, and _____ (hereinafter "Surety"), a corporation organized and existing under the laws of the State of _____ with its principal office in the City of _____, holding a certificate of authority to transact surety business in Arizona issued by the Director of the Department of Insurance pursuant to Title 20, Chapter 2, Article 1, as Surety, are held and firmly bound unto _____ (hereinafter "Obligee") in the amount of _____ (Dollars) (\$ _____), for the payment whereof, the Principal and Surety bind themselves, and their heirs, administrators, executors, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has entered into a certain written contract with the Obligee, dated the _____ day of _____, 20__ for construction of **POLICE WORK AREA AND STORAGE RENOVATION, PD2205.401** which contract is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the Principal promptly pays all moneys due to all persons supplying labor or materials to the Principal or the Principal's subcontractors in the prosecution of the work provided for in said contract, this obligation is void. Otherwise it remains in full force and effect.

PROVIDED, HOWEVER that this bond is executed pursuant to the provisions of Title 34, Chapter 2, Article 2 Arizona Revised Statutes, and all liabilities on this bond will be determined in accordance with the provisions, conditions and limitations of Title 34, Chapter 2, Article 2, Arizona Revised Statutes, to the same extent as if it were copied at length in this Contract.

The prevailing party in a suit on this bond may recover as part of the judgment reasonable attorney fees that may be fixed by a judge of the court.

Witness our hands this _____ day of _____, 20__.

PRINCIPAL

SEAL

AGENT OF RECORD

By _____

SURETY

SEAL

AGENT ADDRESS

EXHIBIT E

CONTRACTOR'S AFFIDAVIT REGARDING SETTLEMENT OF CLAIMS

_____, Arizona

Date _____

Project Name: **POLICE WORK AREA AND STORAGE RENOVATION**

Project No.: **PD2205.401**

To the City of Chandler, Arizona

Gentlemen:

This is to certify that all lawful claims for materials, rental of equipment and labor used in connection with the construction of the above project, whether by subcontractor or claimant in person, have been duly discharged.

The undersigned, for the consideration of \$_____, as set out in the final pay estimate, as full and complete payment under the terms of the contract, hereby waives and relinquishes any and all further claims or right of lien under, in connection with, or as a result of the above described project. The undersigned further agrees to indemnify and save harmless the City of Chandler against any and all liens, claims or liens, suits, actions, damages, charges and expenses whatsoever, which said City may suffer arising out of the failure of the undersigned to pay for all labor performances and materials furnished for the performance of said installation.

Signed and dated at _____, this _____ day of _____ 20_____.

CONTRACTOR

By _____

STATE OF ARIZONA)
) SS
COUNTY OF MARICOPA)

The foregoing instrument was subscribed and sworn to before me this _____ day of _____
20 _____.

Notary Public

My Commission Expires

EXHIBIT F

CERTIFICATE OF COMPLETION

Project: **POLICE WORK AREA AND STORAGE RENOVATION**
Project No.: **PD2205.401**

(TO BE COMPLETED BY CONTRACTOR)

I HEREBY CERTIFY THAT ALL GOODS AND/OR SERVICES REQUIRED BY CITY OF CHANDLER PROJECT NO. **PD2205.401** HAVE BEEN DELIVERED IN ACCORDANCE WITH THE CONTRACT DOCUMENTS AND BID SPECIFICATIONS AND ALL ACTIVITIES REQUIRED BY THE CONTRACTOR UNDER THE CONTRACT HAVE BEEN COMPLETED AS OF _____.

(Date)

FIRM NAME: _____

PRINCIPAL: _____

(Name)

(Signature)

(Title) DATE: _____

CERTIFIED BY ENGINEER/CONSULTANT (IF APPLICABLE):

(Signature) DATE: _____

(Firm Name)

PROJECT ACCEPTED BY USER DEPARTMENT

(Signature) DATE: _____

(Dept. /Div.)

Date of Final Walk-Through

Date As-Built Received

City As-Built Number

EXHIBIT A-1

PROJECT MANUAL



CITY OF CHANDLER, ARIZONA POLICE WORK AREA AND STORAGE RENOVATION

250 E. Chicago Street
Chandler, Arizona

PROJECT NO: PD2205.201

100% CONSTRUCTION DOCUMENTS SUBMITTAL

PREPARED FOR:
**CITY OF CHANDLER
PUBLIC WORKS & UTILITIES
CAPITAL PROJECTS DIVISION
CHANDLER, ARIZONA**

**September 7, 2022
AW Job No. 2021.076**



Arrington Watkins Architects
5240 N. 16th Street
Suite 101
Phoenix, Arizona 85016
Telephone: (602) 279-4373
Fax: (602) 279-9110
A Limited Liability Company

TABLE OF CONTENTS

DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS

General Contractor to provide individual lump sum pricing for each division in the project specifications excluding Division 00 and Division 01. Each division will be measured as a single unit of work and paid at the contract lump sum price, which price will be full compensation for the work completed as related to the division. The approved schedule showing percent of work completed per division will be the basis on which monthly progress payments will be made. Refer to the Owner's General Conditions for additional information.

DIVISION 01 - GENERAL REQUIREMENTS

01 00 00 GENERAL REQUIREMENTS
01 23 00 ALTERNATES

DIVISION 02 - EXISTING CONDITIONS

02 41 19 SELECTIVE DEMOLITION

DIVISION 03 - CONCRETE

03 01 30 MAINTENANCE OF CAST-IN-PLACE CONCRETE
03 30 00 CAST-IN-PLACE CONCRETE

DIVISION 04 - MASONRY

04 22 00 CONCRETE UNIT MASONRY

DIVISION 05 - METALS

NOT USED

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

06 10 53 MISCELLANEOUS ROUGH CARPENTRY
06 20 23 INTERIOR FINISH CARPENTRY
06 41 16 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS
06 64 00 PLASTIC-PANELING

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

07 18 00 TRAFFIC COATINGS
07 21 00 THERMAL INSULATION
07 91 06 DECK AND PARKING JOINT SEALS
07 92 00 JOINT SEALANTS
07 92 19 ACOUSTICAL JOINT SEALANTS
07 95 13.16 EXTERIOR EXPANSION JOINT COVER ASSEMBLIES (ALTERNATE NO. 2)

DIVISION 08 - OPENINGS

08 11 13 HOLLOW METAL DOORS AND FRAMES
08 14 16 FLUSH WOOD DOORS
08 31 13 ACCESS DOORS AND FRAMES
08 41 13 ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS



08 71 00 DOOR HARDWARE
08 80 00 GLAZING
08 87 16 SAFETY AND SECURITY WINDOW FILM

DIVISION 09 - FINISHES

09 22 16 NON-STRUCTURAL METAL FRAMING
09 29 00 GYPSUM BOARD
09 30 13 CERAMIC TILING
09 51 23 ACOUSTICAL TILE CEILINGS
09 65 13 RESILIENT BASE AND ACCESSORIES
09 68 13 TILE CARPETING
09 91 23 INTERIOR PAINTING

DIVISION 10 - SPECIALTIES

10 14 23.16 ROOM-IDENTIFICATION PANEL SIGNAGE
10 26 00 WALL AND DOOR PROTECTION
10 28 00 TOILET, BATH, AND LAUNDRY ACCESSORIES
10 44 13 FIRE EXTINGUISHER CABINETS
10 44 16 FIRE EXTINGUISHERS

DIVISION 11 - EQUIPMENT

NOT USED

DIVISION 12 - FURNISHINGS

12 21 13 HORIZONTAL LOUVER BLINDS
12 36 61.19 QUARTZ AGGLOMERATE COUNTERTOPS

DIVISION 21 - FIRE SUPPRESSION

REFER TO DIVISION 21 TABLE OF CONTENTS

DIVISION 22 - PLUMBING

REFER TO DIVISION 22 TABLE OF CONTENTS

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

REFER TO DIVISION 23 TABLE OF CONTENTS

DIVISION 26 - ELECTRICAL

REFER TO DIVISION 26 TABLE OF CONTENTS

DIVISION 27 - COMMUNICATIONS

REFER TO DIVISION 27 TABLE OF CONTENTS

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

REFER TO DIVISION 28 TABLE OF CONTENTS

END TABLE OF CONTENTS

SECTION 01 00 00

GENERAL CONDITIONS

Refer to City of Chandler General Conditions.

SECTION 01 23 00

ALTERNATES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for alternates.

1.02 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
 - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.03 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.
- D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 SCHEDULE OF ALTERNATES

- A. Alternate No. 1: REMOVAL OF EXISTING SHOOTING RANGE BULLET TRAP
 - 1. Base Bid: Bullet trap to remain in place.
 - 2. Alternate Bid: Remove bullet trap system, support framing and wire.

B. Alternate No. 2: PARKING JOINT SEALS / EXPANSION JOINT COVER ASSEMBLIES

1. Base Bid: DSM-DS Parking Joint Seal (or equal) as described in Section 07 91 06 to be provided if the joint is less than two inches wide.
2. Alternate: SJS Expansion joint and metal joint cover (or equal) as described in Section 07 95 13.16 to be provided if the existing joint is two inches or greater.

END OF SECTION

SECTION 02 41 19
SELECTIVE DEMOLITION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Demolition and removal of selected portions of building or structure.
 - 2. Salvage of existing items to be reused or recycled.

1.02 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.03 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 - 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.04 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.

1.05 INFORMATIONAL SUBMITTALS

- A. Pre-demolition Photographs or Video: Submit before Work begins.

1.06 CLOSEOUT SUBMITTALS

- A. Inventory of items that have been removed and salvaged.

1.07 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. Hazardous materials will be removed by Owner before start of the Work.
 - 2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.
- G. Arrange selective demolition schedule so as not to interfere with Owner's operations.

1.08 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

- C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- D. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
- E. Survey of Existing Conditions: Record existing conditions by use of measured drawings, preconstruction photographs, or preconstruction videotapes.

3.02 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
 - 1. Comply with requirements for existing services/systems interruptions specified in Section 01 11 00 "Summary."
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 - 2. Arrange to shut off utilities with utility companies.
 - 3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.03 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and

finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

- C. Remove temporary barricades and protections where hazards no longer exist.

3.04 SELECTIVE DEMOLITION

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
 - 2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 - 3. 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.
 - 4. Maintain fire watch during and for at least hours after flame-cutting operations.
 - 5. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 - 6. Dispose of demolished items and materials promptly. Comply with requirements in Section 01 74 19 "Construction Waste Management and Disposal."
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Removed and Salvaged Items:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area designated by Owner.
 - 5. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items:
 - 1. Clean and repair items to functional condition adequate for intended reuse.
 - 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 - 3. Protect items from damage during transport and storage.
 - 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.05 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 - 4. Comply with requirements specified in Section 01 74 19 "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.06 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION

SECTION 03 01 30

MAINTENANCE OF CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Removal of deteriorated concrete and subsequent patching.
 - 2. Floor joint repair.
 - 3. Epoxy crack injection.
 - 4. Corrosion-inhibiting treatment.
 - 5. Polymer sealers.

1.02 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: Cured Samples for each exposed product and for each color and texture specified.

1.04 INFORMATIONAL SUBMITTALS

- A. Material certificates.
- B. Product test reports.
- C. Field quality-control reports.

1.05 QUALITY ASSURANCE

- A. Concrete-Maintenance Specialist Qualifications: Engage an experienced concrete-maintenance firm that employs installers and supervisors who are trained and approved by manufacturer to apply packaged patching-mortar, crack-injection adhesive, corrosion-inhibiting treatments and polymer sealers to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing or patching new concrete is insufficient experience for concrete-maintenance work.
- B. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
 - 1. Concrete removal and patching.
 - 2. Floor joint repair.
 - 3. Epoxy crack injection.
 - 4. Polymer sealer.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Source Limitations: For repair products, obtain each color, grade, finish, type, and variety of product from single source and from single manufacturer with resources to provide products of consistent quality in appearance and physical properties.

2.02 BONDING AGENTS

- A. Epoxy-Modified, Cementitious Bonding and Anticorrosion Agent: Manufactured product that consists of water-insensitive epoxy adhesive, portland cement, and water-based solution of corrosion-inhibiting chemicals that forms a protective film on steel reinforcement.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation.
 - b. Dayton Superior.
 - c. Euclid Chemical Company (The); an RPM company.
 - d. MAPEI Corporation.
 - e. Sika Corporation.
 - f. Or preapproved equal.

- B. Epoxy Bonding Agent: ASTM C881/C881M, bonding system Type II or Type V and free of VOCs.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation.
 - b. Dayton Superior.
 - c. Euclid Chemical Company (The); an RPM company.
 - d. MAPEI Corporation.
 - e. Sika Corporation.
 - f. Or preapproved equal.

- C. Latex Bonding Agent, Redispersible: ASTM C1059/C1059M, Type I for use at nonstructural and interior locations unless otherwise indicated.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation.
 - b. Dayton Superior.
 - c. Euclid Chemical Company (The); an RPM company.
 - d. W.R. Meadows, Inc.
 - e. Or preapproved equal.

- D. Latex Bonding Agent, Non-Redispersible: ASTM C1059/C1059M, Type II for use at structural locations and where indicated.

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

- a. ChemMasters, Inc.
- b. Dayton Superior.
- c. Euclid Chemical Company (The); an RPM company.
- d. MAPEI Corporation.
- e. W.R. Meadows, Inc.
- f. Or preapproved equal.

2.03 PATCHING MORTAR

A. Patching Mortar Requirements:

- 1. Only use patching mortars that are recommended by manufacturer for each applicable horizontal, vertical, or overhead use orientation.
- 2. Color and Aggregate Texture: Provide patching mortar and aggregates of colors and sizes necessary to produce patching mortar where indicated that matches existing, adjacent, exposed concrete. Blend several aggregates if necessary to achieve suitable matches.
- 3. Coarse Aggregate for Patching Mortar: ASTM C33/C33M, washed aggregate, Size No. 8, Class 5S. Add to patching-mortar mix only as permitted by patching-mortar manufacturer.

B. Cementitious Patching Mortar: Packaged, dry mix for repair of concrete.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation.
 - b. ChemMasters, Inc.
 - c. Dayton Superior.
 - d. Euclid Chemical Company (The); an RPM company.
 - e. MAPEI Corporation.
 - f. Sika Corporation.
 - g. W.R. Meadows, Inc.
 - h. Or preapproved equal.
- 2. Basis-of-Design Product: Sika Corporation "SikaQuick® 1000"; for the purpose of building up crickets on an existing concrete slab parking deck. It is a one-component, rapid hardening, early strength gain, cementitious, patching mortar for concrete.
- 3. Compressive Strength: Not less than 4000 psi (27.6 MPa) at 1 day, and 7000 psi (48.3 MPa) at 28 days, when tested according to ASTM C109/C109M.

C. Rapid-Strengthening, Cementitious Patching Mortar: Packaged, dry mix, ASTM C928/C928M for repair of concrete.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation.
 - b. ChemMasters, Inc.
 - c. Dayton Superior.
 - d. Euclid Chemical Company (The); an RPM company.
 - e. MAPEI Corporation.
 - f. Sika Corporation.
 - g. W.R. Meadows, Inc.
 - h. Or preapproved equal.

2. Compressive Strength: Not less than 1000 psi (7.0 MPa) within three hours when tested according to ASTM C109/C109M.
- D. Polymer-Modified, Cementitious Patching Mortar: Packaged, dry mix for repair of concrete and that contains a non-redispersible latex additive as either a dry powder or a separate liquid that is added during mixing.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation.
 - b. ChemMasters, Inc.
 - c. Dayton Superior.
 - d. Euclid Chemical Company (The); an RPM company.
 - e. MAPEI Corporation.
 - f. Sika Corporation.
 - g. W.R. Meadows, Inc.
 - h. Or preapproved equal.
 2. Compressive Strength: Not less than 4000 psi (27.6 MPa) at 28 days when tested according to ASTM C109/C109M.
- E. Polymer-Modified, Silica-Fume-Enhanced, Cementitious Patching Mortar: Packaged, dry mix for repair of concrete and that contains silica fume complying with ASTM C1240 and a non-redispersible latex additive as either a dry powder or a separate liquid that is added during mixing.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation.
 - b. Euclid Chemical Company (The); an RPM company.
 - c. MAPEI Corporation.
 - d. Sika Corporation.
 - e. W.R. Meadows, Inc.
 - f. Or preapproved equal.
 2. Compressive Strength: Not less than 4000 psi (27.6 MPa) at 28 days when tested according to ASTM C109/C109M.

2.04 JOINT FILLER

- A. Epoxy Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A Shore durometer hardness of at least 80 according to ASTM D2240.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation.
 - b. Dayton Superior.
 - c. Euclid Chemical Company (The); an RPM company.
 - d. MAPEI Corporation.
 - e. Sika Corporation.
 - f. Or preapproved equal.

- B. Polyurea Joint Filler: Two-component, semirigid, 100 percent solids, polyurea resin with a Type A Shore durometer hardness of at least 80 according to ASTM D2240.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation.
 - b. Euclid Chemical Company (The); an RPM company.
 - c. Or preapproved equal.
- C. Color: As selected by Architect from full range of industry colors.

2.05 EPOXY CRACK-INJECTION MATERIALS

- A. Epoxy Crack-Injection Adhesive: ASTM C881/C881M, bonding system Type IV at structural locations and where indicated, Type I at other locations; free of VOCs.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation.
 - b. Dayton Superior.
 - c. Euclid Chemical Company (The); an RPM company.
 - d. MAPEI Corporation.
 - e. Sika Corporation.
 - f. W.R. Meadows, Inc.
 - g. Or preapproved equal.
 - 2. Capping Adhesive: Product manufactured for use with crack-injection adhesive by same manufacturer.

2.06 CORROSION-INHIBITING MATERIALS

- A. Corrosion-Inhibiting Treatment: Waterborne solution of alkaline corrosion-inhibiting chemicals for concrete-surface application that penetrates concrete by diffusion and forms a protective film on steel reinforcement.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation.
 - b. Euclid Chemical Company (The); an RPM company.
 - c. Sika Corporation.
 - d. Or preapproved equal.

2.07 POLYMER-SEALER MATERIALS

- A. Epoxy Polymer Sealer: Low-viscosity epoxy, penetrating sealer and crack filler recommended by manufacturer for penetrating and sealing cracks in exterior concrete traffic surfaces; VOC content 100 g/L or less.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. BASF Corporation.
- b. Dayton Superior.
- c. Euclid Chemical Company (The); an RPM company.
- d. Sika Corporation.
- e. Or preapproved equal.

2. Color: As selected by Architect from full range of industry colors.

B. Methacrylate Polymer Sealer: Low-viscosity, high-molecular-weight methacrylate, penetrating sealer and crack filler recommended by manufacturer for penetrating and sealing cracks in exterior concrete traffic surfaces; VOC content 100 g/L or less.

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

- a. BASF Corporation.
- b. Sika Corporation.
- c. Or preapproved equal.

2. Color: As selected by Architect from full range of industry colors.

2.08 MISCELLANEOUS MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I, II, or III unless otherwise indicated.

B. Water: Potable.

2.09 MIXES

A. General: Mix products, in clean containers, according to manufacturer's written instructions.

B. Dry-Pack Mortar: Mix required type(s) of patching-mortar dry ingredients with just enough liquid to form damp cohesive mixture that can be squeezed by hand into a ball but is not plastic.

PART 3 - EXECUTION

3.01 CONCRETE MAINTENANCE

A. Have concrete-maintenance work performed only by qualified concrete-maintenance specialist.

B. Comply with manufacturers' written instructions for surface preparation and product application.

3.02 EXAMINATION

A. Notify Architect seven days in advance of dates when areas of deteriorated or delaminated concrete and deteriorated reinforcing bars will be located.

B. Locate areas of deteriorated or delaminated concrete using hammer or chain-drag sounding and mark boundaries. Mark areas for removal by simplifying and squaring off boundaries. At columns and walls make boundaries level and plumb unless otherwise indicated.

C. Pachometer Testing: Locate at least three reinforcing bars using a pachometer, and drill test holes to determine depth of cover. Calibrate pachometer using depth of cover measurements, and verify depth of cover in removal areas using pachometer.

- D. Perform surveys as the Work progresses to detect hazards resulting from concrete-maintenance work.

3.03 SURFACE PREPARATION

- A. Concrete surface must be clean and sound.
- B. Remove all deteriorated concrete, dirt, oil, grease, and other bond-inhibiting materials from the area to be repaired.
- C. Be sure repair area is not less than 1/4 inch (6 mm) deep.
- D. Preparation work should be done by high pressure water blast, scabbler or other appropriate mechanical means to obtain an exposed aggregate surface profile of +/- 1/8 inch (3 mm) (minimum CSP-6).
- E. To ensure optimum repair results, the effectiveness of decontamination and preparation should be assessed by a Tensile Adhesion Strength (pull-off) test.
- F. Saw cutting perimeter edges of concrete repair area at a dovetail is preferred.
- G. Substrate should be Saturated Surface Dry (SSD) with clean water prior to application. No standing water should remain during application.
- H. Rust, scale, mortar, concrete, dust and other loose and deleterious material which reduces bond or contributes to corrosion shall be removed from steel reinforcement.
- I. Surfaces shall be prepared using abrasive blast cleaning techniques or high pressure water blasting to achieve a bright metal finish.

3.04 PREPARATION

- A. Ensure that supervisory personnel are on-site and on duty when concrete maintenance work begins and during its progress.
- B. Protect persons, motor vehicles, surrounding surfaces of building being repaired, building site, plants, and surrounding buildings from harm resulting from concrete maintenance work.
 - 1. Comply with each product manufacturer's written instructions for protections and precautions.
 - 2. Contain dust and debris generated by concrete maintenance work and prevent it from reaching the public or adjacent surfaces.
 - 3. Protect floors and other surfaces along haul routes from damage, wear, and staining.
 - 4. Provide supplemental sound-control treatment to isolate removal and dismantling work from other areas of the building.
 - 5. Neutralize and collect alkaline and acid wastes for disposal off Owner's property.
- C. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify Architect immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is in working order.
 - 1. Prevent solids such as aggregate or mortar residue from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from concrete maintenance work.

2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.
- D. Preparation for Concrete Removal: Make explorations, probes, and inquiries as necessary to determine condition of construction to be removed in the course of repair.
1. Verify that affected utilities have been disconnected and capped.
 2. Provide and maintain shoring, bracing, and temporary structural supports as required to preserve stability and prevent unexpected or uncontrolled movement, settlement, or collapse of construction being demolished and construction and finishes to remain. Strengthen or add new supports when required during progress of removal work.
- E. Reinforcing-Bar Preparation: Remove loose and flaking rust from exposed reinforcing bars by wire brushing until only tightly adhered light rust remains.
1. Where section loss of reinforcing bar is more than 25 percent, or 20 percent in two or more adjacent bars, cut bars and remove and replace as indicated on Drawings.
 2. Remove additional concrete as necessary to provide at least 3/4-inch (19-mm) clearance at existing and replacement bars.
 3. Splice replacement bars to existing bars according to ACI 318 (ACI 318M) by lapping, welding, or using mechanical couplings.
- F. Preparation of Floor Joints for Repair: Saw-cut joints full width to edges and depth of spalls, but not less than 3/4 inch (19 mm) deep. Clean out debris and loose concrete; vacuum or blow clear with compressed air.

3.05 REMOVAL OF CONCRETE

- A. Do not overload structural elements with debris.
- B. Saw-cut perimeter of areas indicated for removal to a depth of at least 1/2 inch (13 mm). Make cuts perpendicular to concrete surfaces and no deeper than cover on reinforcement.
- C. Remove deteriorated and delaminated concrete by breaking up and dislodging from reinforcement.
- D. Remove additional concrete if necessary to provide a depth of removal of at least 1/2 inch (13 mm) over entire removal area.
- E. Where half or more of the perimeter of reinforcing bar is exposed, bond between reinforcing bar and surrounding concrete is broken, or reinforcing bar is corroded, remove concrete from entire perimeter of bar and to provide at least 3/4-inch (19-mm) clearance around bar.
- F. Test areas where concrete has been removed by tapping with hammer, and remove additional concrete until unsound and disbonded concrete is completely removed.
- G. Provide surfaces with a fractured profile of at least 1/8 inch (3 mm) that are approximately perpendicular or parallel to original concrete surfaces. At columns and walls, make top and bottom surfaces level unless otherwise directed.
- H. Thoroughly clean removal areas of loose concrete, dust, and debris.

3.06 APPLICATION OF BONDING AGENT

- A. Epoxy-Modified, Cementitious Bonding and Anticorrosion Agent: Apply to reinforcing bars and concrete. Apply to reinforcing bars in two coats, allowing first coat to dry two to three hours before applying second coat. Allow to dry before placing patching mortar.
- B. Epoxy Bonding Agent: Apply to reinforcing bars and concrete, leaving no pinholes or other uncoated areas. Apply to reinforcing bars in at least two coats, allowing first coat to dry before applying second coat. Place patching mortar while epoxy is still tacky. If epoxy dries, recoat before placing patching mortar.
- C. Latex Bonding Agent, Type I: Apply to concrete by brush roller or spray. Allow to dry before placing patching mortar.
- D. Latex Bonding Agent, Type II: Mix with portland cement and scrub into concrete surface. Place patching mortar while bonding agent is still wet. If bonding agent dries, recoat before placing patching mortar.
- E. Slurry Coat for Cementitious Patching Mortar: Wet substrate thoroughly and then remove standing water. Scrub a slurry of neat patching mortar mixed with latex bonding agent into substrate, filling pores and voids.

3.07 INSTALLATION OF PATCHING MORTAR

- A. Place patching mortar as specified in this article unless otherwise recommended in writing by manufacturer or where dry-pack mortar is indicated.
 - 1. Provide forms where necessary to confine patch to required shape.
 - 2. Wet substrate and forms thoroughly and then remove standing water.
- B. Pretreatment: Apply specified bonding agent.
- C. General Placement: Place patching mortar by troweling toward edges of patch to force intimate contact with edge surfaces. For large patches, fill edges first and then work toward center, always troweling toward edges of patch. At fully exposed reinforcing bars, force patching mortar to fill space behind bars by compacting with trowel from sides of bars.
- D. Vertical Patching: Place material in lifts of not more than thickness recommended by manufacturer. Do not feather edge.
- E. Overhead Patching: Place material in lifts of not more than thickness recommended by manufacturer. Do not feather edge.
- F. Consolidation: After each lift is placed, consolidate material and screed surface.
- G. Multiple Lifts: Where multiple lifts are used, score surface of lifts to provide a rough surface for placing subsequent lifts. Allow each lift to reach final set before placing subsequent lifts.
- H. Finishing: Allow surfaces of lifts that are to remain exposed to become firm and then finish to a surface matching adjacent concrete.
- I. Curing: Wet-cure cementitious patching materials, including polymer-modified cementitious patching materials, for not less than seven days by water-fog spray or water-saturated absorptive cover.

3.08 INSTALLATION OF DRY-PACK-MORTAR

- A. Use dry-pack mortar for deep cavities and where indicated. Place as specified in this article unless otherwise recommended in writing by manufacturer.
 - 1. Provide forms where necessary to confine patch to required shape.
 - 2. Wet substrate and forms thoroughly and then remove standing water.
- B. Pretreatment: Apply specified bonding agent.
- C. Place dry-pack mortar into cavity by hand, and compact tightly into place. Do not place more material at a time than can be properly compacted. Continue placing and compacting until patch is approximately level with surrounding surface.
- D. After cavity is filled and patch is compacted, trowel surface to match profile and finish of surrounding concrete.
- E. Wet-cure patch for not less than seven days by water-fog spray or water-saturated absorptive cover.

3.09 FLOOR-JOINT REPAIR

- A. Cut out deteriorated concrete and reconstruct sides of joint with patching mortar as indicated on Drawings. Install joint filler in nonmoving floor joints where indicated and as specified in this article.
- B. Depth: Install joint filler to a depth of at least 3/4 inch (19 mm). Use fine silica sand no more than 1/4 inch (6 mm) deep to close base of joint. Do not use sealant backer rods or compressible fillers below joint filler.
- C. Top Surface: Install joint filler so that when cured, it is flush at top surface of adjacent concrete. If necessary, overfill joint and remove excess when filler has cured.

3.10 EPOXY CRACK INJECTION

- A. Clean cracks with oil-free compressed air or low-pressure water to remove loose particles.
- B. Clean areas to receive capping adhesive of oil, dirt, and other substances that would interfere with bond.
- C. Place injection ports as recommended by epoxy manufacturer, spacing no farther apart than thickness of member being injected. Seal injection ports in place with capping adhesive.
- D. Seal cracks at exposed surfaces with a ribbon of capping adhesive at least 1/4 inch (6 mm) thick by 1 inch (25 mm) wider than crack.
- E. Inject cracks wider than 0.003 inch (0.075 mm) to a depth of 8 inches (200 mm).
- F. Inject epoxy adhesive, beginning at widest part of crack and working toward narrower parts. Inject adhesive into ports to refusal, capping adjacent ports when they extrude epoxy. Cap injected ports and inject through adjacent ports until crack is filled.
- G. After epoxy adhesive has set, remove injection ports and grind surfaces smooth.

3.11 APPLICATION OF CORROSION-INHIBITING-TREATMENT

- A. Apply corrosion-inhibiting treatment to surfaces indicated on Drawings, from wall-to-wall or curb-to-curb and from joint-to-joint in the perpendicular direction.
- B. Apply by brush, roller, or airless spray in two coats at manufacturer's recommended application rate. Remove film of excess treatment before patching treated concrete or applying a sealer.

3.12 APPLICATION OF POLYMER SEALER

- A. Apply polymer sealer by brush, roller, or airless spray at manufacturer's recommended application rate.
- B. Apply to traffic-bearing surfaces, including parking areas and walks.

3.13 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform the following tests and inspections:
 - 1. Packaged, Cementitious Patching Mortar: Two randomly selected sets of samples for each type of mortar required, tested according to ASTM C928/C928M.
 - 2. Joint Filler: Core-drilled samples to verify proper installation.
 - a. Testing Frequency: One sample for each 100 feet (30 m) of joint filled.
 - b. Where samples are taken, refill holes with joint filler.
 - 3. Epoxy Crack Injection: Core-drilled samples to verify proper installation.
 - a. Testing Frequency: Three samples from mockup and one sample for each 100 feet (30 m) of crack injected.
 - b. Where samples are taken, refill holes with epoxy mortar.
- C. Product will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, vapor barrier, and finishes.

- 1. Colored concrete interior floor slabs.

- B. Related Requirements:

- 1. Maricopa Association of Governments (MAG) Uniform Standard Specifications for Public Works and City of Chandler Supplemental Specifications for drainage fill under slabs-on-grade.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement.

1.03 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Material certificates.
- C. Material test reports.
- D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer, detailing fabrication, assembly, and support of formwork.
- E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

1.04 QUALITY ASSURANCE

- A. Concrete Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Dry-Shake Floor Hardener Installer: List of 5 projects of similar size installed in the prior 5 years complete with contact information.
- C. Liquid Densifier/Sealer Installer: Manufacturer approved contractor shall have completed 5 projects of similar size within the prior 5 years and shall submit current certificate of approval or

letter of approval issued by Liquid Densifier/Dealer manufacturer.

- D. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- E. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
- F. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."
- G. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
 - 3. ACI 306.1, "Standard Specification for Cold Weather Concreting."
 - 4. ACI 308.1, "Standard Specification for Curing Concrete."
 - 5. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
 - 6. ACI 347, "Guide to Formwork for Concrete."
- H. AASHTO Publication:
 - 1. AASHTO T318, "Standard Method of Test for Water Content of Freshly Mixed Concrete Using Microwave Oven Drying."
- I. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- J. Mockups: Cast concrete slab-on-grade, and formed surface where applicable, panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship.
 - 1. Build panel approximately 200 sq. ft. (18.6 sq. m) for slab-on-grade and 100 sq. ft. (9.3 sq. m) for formed surface in the location indicated or, if not indicated, as directed by Architect.
 - 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- K. Preinstallation Conference: Conduct conference at Project site.
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Schedule preinstallation conference at least 7 days prior to Work and provide written agenda to all attendees at least 7 days before conference. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete Subcontractor.
 - e. Special concrete finish Subcontractor.

PART 2 - PRODUCTS

2.01 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
 - 2. Products:
 - a. Euclid Chemical Company (The): Euco Super Slip.
 - b. Euclid Chemical Company (The): Form-Eze Natural.
 - c. US Mix Products; EZKote Green.

2.02 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
 - 1. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class I zinc coated after fabrication and bending.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.
- C. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.
- D. Galvanized-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from galvanized-steel wire into flat sheets.
- E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice."

2.03 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut true to length with ends square and free of burrs.
- B. Construction Joint Slab on Ground Plate Dowels: Plate material shall be 1/4 inch by 4-1/2 inches square, ASTM A36 steel and shall be Diamond Dowel System, by PNA Construction Technologies. Locate plate dowels at construction joints. Do not shear plates. Remove burrs at edges of plates.
- C. Contraction Joint Protection: Load plate shall be smooth steel plate bars, ASTM A36, and shall be Load Plate Basket or PD³ Basket by PNA Construction Technologies. Locate Load Plate Baskets at contraction joints so noted on the plans. Do not shear. Remove burrs.

2.04 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I/II, gray. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F.
- B. Normal-Weight Aggregates: ASTM C 33, graded.
 - 1. Maximum Coarse-Aggregate Size: 1 inches (25 mm) nominal.
 - a. Combined aggregate gradation for slabs and other designated concrete shall be 8% - 18% for large top size aggregates (1-1/2 inch) or 8% - 22% for smaller top size aggregates (1 inch or 3/4 inch) retained on each sieve below the top size and above the No. 100.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M and potable.

2.05 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
 - 1. Products:
 - a. Euclid Chemical Company (The); Air Mix or AEA-92 Series.
 - b. Grace Construction Products; Darex or Daravair series.
 - c. BASF; MB-VR or MB-A.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride. Provide all admixtures from same manufacturer to ensure compatibility.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - a. Products:
 - 1) Euclid Chemical Company (The); Eucon Series.
 - 2) BASF; Pozzoloth Series.
 - 3) WR Grace; WRDA Hycol.
 - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - a. Products:
 - 1) Euclid Chemical Company (The); Eucon Retarder Series.
 - 2) BASF; Pozzoloth Series.
 - 3) WR Grace; Daratard Series.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.

- a. Products:
 - 1) Euclid Chemical Company (The); Eucon Retarder Series.
 - 2) BASF; Pozzolith Series.
 - 3) WR Grace; Daratard Series.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 - a. Products:
 - 1) Euclid Chemical Company (The); Eucon 37 or Plastol Series.
 - 2) BASF; Rheobuild 1000 or Glenium Series.
 - 3) WR Grace; Daracem or Adva Series.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 - a. Products:
 - 1) Euclid Chemical Company (The); Eucon 537.
 - 2) BASF; Rheobuild Series.
 - 3) WR Grace; Daracem series.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
 - a. Products:
 - 1) Euclid Chemical Company (The); Eucon 537.
 - 2) BASF; Rheobuild Series.
 - 3) WR Grace; Daracem Series.
- C. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Euclid Chemical Company (The); an RPM company.
 - b. Davis Colors.
 - c. Dayton Superior Corporation.
 - d. Scofield, L. M. Company.
 - e. Solomon Colors, Inc.
 2. Color: As selected by Architect from manufacturer's full range.
 3. Liquid Dose Rate: 1.54 lbs per 94 lb sack of cement.
 4. Powder Dose Rate: 1.0 lbs per 94 lb sack of cement.
 5. Color Floor Slab Locations: Interior slabs between

2.06 VAPOR BARRIER

- A. Sheet Vapor Barrier: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.
 1. Basis-of-Design Product: Stego Industries, LLC; Stego Wrap Vapor Barrier.

2.07 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating. Curing compound is to be removed per manufacturer's instructions after curing is complete.
- F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating. Curing compound is to be removed per manufacturer's instructions after curing is complete.
- G. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
 - 1. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- H. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
 - 1. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.08 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

2.09 CONCRETE MIXTURES

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
- B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by up to 40 percent.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing or high-range water-reducing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete, and concrete with a water-cementitious materials ratio below 0.50.

D. Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: Per General Structural Notes on Drawings.
2. Maximum Water-Cementitious Materials Ratio: Per General Structural Notes on Drawings.
3. Slump Limit: Per General Structural Notes on Drawings.
4. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

2.10 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.11 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

2.12 FLOOR AND SLAB TREATMENTS

A. Emery Dry-Shake Floor Hardener: Unpigmented, factory-packaged, dry combination of portland cement, graded emery aggregate, and plasticizing admixture; with emery aggregate consisting of no less than 60 percent of total aggregate content.

1. Products:
 - a. Euclid Chemical Company (The); Surfex E.
 - b. Anti-Hydro; Emery Floor Shake-On.
2. Color: As selected by Architect from manufacturer's full range.

B. Metallic Dry-Shake Floor Hardener: Unpigmented, factory-packaged, dry combination of portland cement, graded metallic aggregate, rust inhibitors, and plasticizing admixture; with metallic aggregate consisting of no less than 65 percent of total aggregate content.

1. Products:
 - a. Euclid Chemical Company (The); Euco-Plate HD.
 - b. BASF; Masterplate 200.
2. Color: As selected by Architect from manufacturer's full range.

C. Unpigmented Mineral Dry-Shake Floor Hardener: Factory-packaged dry combination of portland cement, graded quartz aggregate, and plasticizing admixture.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Construction Chemicals - Building Systems; Maximent.
 - b. Dayton Superior Corporation; Quartz Tuff.
 - c. Euclid Chemical Company (The), an RPM company; Surfex.
 - d. L&M Construction Chemicals, Inc.; Quartzplate FF.

2.13 LIQUID FLOOR TREATMENTS

- A. VOC Content: Liquid floor treatments shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Curecrete Distribution Inc.; Ashford Formula.
 - b. Dayton Superior Corporation; Day-Chem Sure Hard (J-17).
 - c. Euclid Chemical Company (The), Eucosil.
 - d. L&M Construction Chemicals, Inc.; Seal Hard.
 - e. Meadows, W. R., Inc.; LIQUI-HARD.
- C. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Advanced Floor Products; Retro-Plate 99.
 - b. L&M Construction Chemicals, Inc.; FGS Hardener Plus.

PART 3 - EXECUTION

3.01 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Chamfer exterior corners and edges of permanently exposed concrete.

3.02 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.03 VAPOR RETARDERS

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.
- B. Inspect vapor barrier for tears, damage, and improper details at laps, penetrations, and terminations. Repair defects prior to concrete placement.

3.04 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.05 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
- E. Waterstops: Install in construction joints and at other joints indicated according to manufacturer's written instructions.

3.06 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
- C. Cold-Weather Placement: Comply with ACI 306.1.
 - 1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- D. Hot-Weather Placement: Comply with ACI 301.

1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Concrete Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.
3. Use evaporation retarder when high ambient and concrete temperatures, low humidity, and wind will cause rapid moisture loss from surface of plastic concrete.

3.07 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 1. Apply to concrete surfaces exposed to public view, to be covered with a coating or covering material applied directly to concrete.
- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
 2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
 3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.08 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in one direction.
 1. Apply scratch finish to surfaces to receive mortar setting beds for bonded cementitious floor

finishes, except concrete sidewalks.

- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
 - 1. Apply float finish to all surfaces unless noted otherwise.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 1. Apply a trowel finish to surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 - 2. Finish and measure surface so gap at any point between concrete surface and an unlevleled, freestanding, 10-ft.- (3.05-m-) long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch (6 mm).
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to exterior surfaces where ceramic tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
 - 1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, sidewalks, and elsewhere as indicated.

3.09 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

- a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

3.10 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

3.11 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

END OF SECTION

SECTION 04 22 00

CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Concrete masonry units (CMU's).
2. Steel reinforcing bars.

1.02 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Masonry Contractor's expense.

1. Concrete Masonry Unit Test: For each type of unit required, according to ASTM C 140 for compressive strength.
2. Mortar Test (Property Specification): For each mix required, according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
3. Mortar Test (Property Specification): For each mix required, according to ASTM C 780 for compressive strength.
4. Grout Test (Compressive Strength): For each mix required, according to ASTM C 1019.

1.03 ACTION SUBMITTALS

- A. Product Data:** For each type of product indicated.
- B. Shop Drawings:** For reinforcing steel. Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement. Show elevations of reinforced walls.
- C. Samples:** For each type and color of exposed masonry unit and colored mortar.

1.04 INFORMATIONAL SUBMITTALS

- A. Material Certificates:** For each type and size of product indicated. For masonry units include data on material properties.
- B. Mix Designs:** For each type of mortar and grout. Include description of type and proportions of ingredients.
1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
 2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

1.05 QUALITY ASSURANCE

- A. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.
- B. Mock-Up Sample Panels: Build mock-up sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 01 40 00 "Quality Requirements" for mock-ups.
 - 1. Build mock-up sample panels for typical exterior and interior walls in sizes approximately 60-inches (1500-mm) long by 48-inches (1200-mm) high by full thickness.

1.06 PROJECT CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
- C. Scaffolding, runways and ladders required for work under this Section shall be provided by masonry contractor, and shall be heavy trades type substantially built and in compliance with State labor laws, safety codes and other regulatory agencies as applicable to this project.
- D. Store units off the ground in a dry location, covered and protected from absorbing moisture.

PART 2 - PRODUCTS

2.01 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.
- B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.02 CONCRETE MASONRY UNITS

- A. General / Appearance to match existing: Integrally colored, modular, multi-core concrete block meeting the requirements of ASTM C90. Emulates the appearance of a clay brick with a soft, striated finish.
 - 1. Basis of Design Product: Founders Finish, from Echelon.
 - 2. Type "CMU-1" Dimensions:
 - a. Height: Nominal 4 inches.
 - b. Length: Nominal 16 inches.
 - c. Depth: Nominal 4 inches.
 - 3. Type "CMU-2" Dimensions:

- a. Height: Nominal 4 inches.
 - b. Length: Nominal 16 inches.
 - c. Depth: Nominal 8 inches.
- B. Shapes: Provide shapes indicated and for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
- C. Integral Water Repellent: Provide units made with liquid polymeric, integral water repellent admixture that does not reduce flexural bond strength for exposed units.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ACM Chemistries, Inc.; RainBloc.
 - b. BASF; MasterPel Plus.
 - c. Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block.
- D. CMUs: ASTM C 90.
 - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2000-psi.
 - 2. Density Classification: Medium weight

2.03 MASONRY LINTELS

- A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from open-ended bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout.

2.04 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Aggregate for Mortar: ASTM C 144.
 - 1. For joints less than 1/4-inch (6-mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
 - 2. White-Mortar Aggregates: Natural white sand or crushed white stone.
 - 3. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- E. Aggregate for Grout: ASTM C 404.
- F. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Euclid Chemical Company (The); Accelguard 80.

- b. Grace Construction Products, W. R. Grace & Co. - Conn.; Morset.
 - c. Sonneborn Products, BASF; Trimix-NCA.
- G. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs, containing integral water repellent by same manufacturer.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ACM Chemistries, Inc.; RainBloc for Mortar.
 - b. BASF; Master Rheapel Mortar Admixture.
 - c. Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.
- H. Water: Potable.

2.05 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).
- B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.
 - 1. Interior Walls: Hot-dip galvanized, carbon steel.
 - 2. Exterior Walls: Hot-dip galvanized, carbon steel.
 - 3. Wire Size for Side Rods: 0.148-inch (3.77-mm) diameter.
 - 4. Wire Size for Cross Rods: 0.148-inch (3.77-mm) diameter.
 - 5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16-inch (407-mm) o.c.
 - 6. Provide in lengths of not less than 10-feet (3-m), with prefabricated corner and tee units.

2.06 TIES AND ANCHORS

- A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.
 - 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.
 - 2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
 - 3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Anchor Bolts: Headed steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.

2.07 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing complying with Section 07 62 00 "Sheet Metal Flashing and Trim" and as follows:
 - 1. Metal Drip Edge: Fabricate from stainless steel. Extend at least 3-inch (76-mm) into wall and 1/2-inch (13-mm) out from wall, with outer edge bent down 30 degrees and hemmed.
 - 2. Metal Sealant Stop: Fabricate from stainless steel. Extend at least 3-inch (76-mm) into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for

3/4-inch (19-mm) and down into joint 1/4-inch (6-mm) to form a stop for retaining sealant backer rod.

B. Flexible Flashing: Use one of the following unless otherwise indicated:

1. Copper-Laminated Flashing: 5-oz./sq. ft. (1.5-kg/sq. m copper sheet bonded between 2 layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Advanced Building Products Inc.; Copper Fabric Flashing.
 - 2) Dayton Superior Corporation, Dur-O-Wal Division; Copper Fabric Thru-Wall Flashing.
 - 3) Hohmann & Barnard, Inc.; H & B C-Fab Flashing.
 - 4) Phoenix Building Products; Type FCC-Fabric Covered Copper.
 - 5) Sandell Manufacturing Co., Inc.; Copper Fabric Flashing.
 - 6) York Manufacturing, Inc.; Multi-Flash 500.
2. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040-inch (1.02-mm).
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Advanced Building Products Inc.; Peel-N-Seal.
 - 2) Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.
 - 3) Dayton Superior Corporation, Dur-O-Wal Division; Dur-O-Barrier Thru-Wall Flashing.
 - 4) Fiberweb, Clark Hammerbeam Corp.; Aquaflash 500.
 - 5) Grace Construction Products, W. R. Grace & Co. - Conn.; Perm-A-Barrier Wall Flashing.
 - 6) Heckmann Building Products Inc.; No. 82 Rubberized-Asphalt Thru-Wall Flashing.
 - 7) Hohmann & Barnard, Inc.; Textroflash.
 - 8) W. R. Meadows, Inc.; Air-Shield Thru-Wall Flashing.
 - 9) Polyguard Products, Inc.; Polyguard 300.
 - 10) Sandell Manufacturing Co., Inc.; Sando-Seal.
 - 11) Williams Products, Inc.; Everlastic MF-40.
3. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) DuPont; Thru-Wall Flashing.
 - 2) Hohmann & Barnard, Inc.; Flex-Flash.
 - 3) Hyload, Inc.; Hyload Cloaked Flashing System.
 - 4) Mortar Net USA, Ltd.; Total Flash.
4. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D 4637, 0.040-inch (1.0-mm) thick.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Carlisle Coatings & Waterproofing; Pre-Kleened EPDM Thru-Wall Flashing.

- 2) Firestone Specialty Products; FlashGuard.
- 3) Heckmann Building Products Inc.; No. 81 EPDM Thru-Wall Flashing.
- 4) Hohmann & Barnard, Inc.; Epra-Max EPDM Thru-Wall Flashing.
- 5) Sandell Manufacturing Co., Inc.; EPDM Flashing.

- C. Single-Wythe CMU Flashing System: System of CMU cell flashing pans and interlocking CMU web covers made from high-density polyethylene incorporating chemical stabilizers that prevent UV degradation. Cell flashing pans have integral weep spouts that are designed to be built into mortar bed joints and weep collected moisture to the exterior of CMU walls and that extend into the cell to prevent clogging with mortar.

1. Products: Subject to compliance with requirements, provide the following:

- a. Mortar Net USA, Ltd.; Blok-Flash.

- D. Solder and Sealants for Sheet Metal Flashings: As specified in Section 07 62 00 "Sheet Metal Flashing and Trim."
- E. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.08 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; formulated from neoprene, urethane or PVC.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

2.09 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
1. Do not use calcium chloride in mortar or grout.
 2. Use portland cement-lime mortar unless otherwise indicated.
 3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide Type S mortar for all applications unless another type is indicated.
- D. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, Table 1.
3. Provide grout with a slump of 8- to 11-inch (203- to 279-mm) as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.01 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation do not vary by more than plus 1/2-inch (12-mm) or minus 1/4-inch (6-mm).
2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2-inch (12-mm).
3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4-inch (6-mm) in a story height or 1/2-inch (12-mm) total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4-inch in 10-feet (6-mm in 3-m), or 1/2-inch (12-mm) maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8-inch in 10-feet (3-mm in 3-m), 1/4-inch in 20-feet (6-mm in 6-m), or 1/2-inch (12-mm) maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4-inch in 10-feet (6-mm in 3-m), 3/8-inch in 20-feet (9-mm in 6-m), or 1/2-inch (12-mm) maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8-inch in 10-feet (3-mm in 3-m), 1/4-inch in 20-feet (6-mm in 6-m), or 1/2-inch (12-mm) maximum.
5. For lines and surfaces do not vary from straight by more than 1/4-inch in 10-feet (6-mm in 3-m), 3/8-inch in 20-feet (9-mm in 6-m), or 1/2-inch (12-mm) maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8-inch (3-mm), with a maximum thickness limited to 1/2-inch (12-mm).
2. For head and collar joints, do not vary from thickness indicated by more than plus 3/8-inch (9-mm) or minus 1/4-inch (6-mm).
3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8-inch (3-mm).

3.02 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

- C. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- F. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- G. Fill cores in hollow CMUs with grout 24-inch (600-mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.03 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs as follows:
 - 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
 - 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
 - 3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
 - 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.04 MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8-inch (16-mm) on exterior side of walls, 1/2-inch (13-mm) elsewhere. Lap reinforcement a minimum of 6-inch (150-mm).
 - 1. Space reinforcement as indicated on Drawings.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.

3.05 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:

1. Provide an open space not less than 1/2-inch (13-mm) wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24-inch (610-mm) o.c. vertically and 36-inch (915-mm) o.c. horizontally.

3.06 FLASHING

- A. General: Install embedded flashing in masonry at lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
 2. At lintels, extend flashing a minimum of 6-inch (150-mm) into masonry at each end. At heads and sills, extend flashing 6-inch (150-mm) at ends and turn up not less than 2-inch (50-mm) to form end dams.
 3. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2-inch (13-mm) back from outside face of wall and adhere flexible flashing to top of metal drip edge.
 4. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2-inch (13-mm) back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
- C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

3.07 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

3.08 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at CMR's expense.
- B. Inspections: Level B special inspections according to the "International Building Code."
 - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
 - 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
 - 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
- D. Testing Frequency: One set of tests for each 5000 sq. ft. (464 sq. m) of wall area or portion thereof.
- E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.
- G. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.
- H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

3.09 REPAIRING, POINTING, AND CLEANING

- A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
 - 2. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.10 MASONRY WASTE DISPOSAL

- A. Waste Disposal: Remove all masonry waste from the Site and dispose of legally off Owner's property.

END OF SECTION

SECTION 06 10 53

MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Framing with dimension lumber.
 - 2. Wood blocking and nailers.
 - 3. Wood furring.
 - 4. Wood sleepers.
 - 5. Plywood backing panels.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.

1.03 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For the following, from ICC-ES:
 - 1. Fire-retardant-treated wood.
 - 2. Power-driven fasteners.

PART 2 - PRODUCTS

2.01 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 15 percent unless otherwise indicated.

2.02 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
 - 1. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201 at 92 percent relative humidity. Use where exterior type is not indicated.

2. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D5664, and design value adjustment factors shall be calculated according to ASTM D6841.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.
- C. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
- D. Application: Treat items indicated on Drawings, and the following:
 1. Concealed blocking.
 2. Wood cants, nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing.
 3. Plywood backing panels.

2.03 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 1. Blocking.
 2. Nailers.
 3. Cants.
 4. Furring.
 5. Grounds.
- B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.

2.04 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C in thickness indicated or, if not indicated, not less than 1/2-inch (13-mm) nominal thickness.

2.05 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
 1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.
- B. Screws for Fastening to Metal Framing: ASTM C1002, length as recommended by screw manufacturer for material being fastened.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.
- D. Do not splice structural members between supports unless otherwise indicated.
- E. Comply with AWPAC M4 for applying field treatment to cut surfaces of preservative-treated lumber.
- F. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

END OF SECTION

SECTION 06 20 23
INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Interior trim.
 - 2. Interior plywood paneling.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.
- B. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

- A. Lumber: DOC PS 20.
 - 1. Factory mark each piece of lumber with grade stamp of inspection agency indicating grade, species, moisture content at time of surfacing, and mill.
 - a. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by grading agency.
- B. Hardwood Plywood: Core materials of plywood or MDF type of glue recommended by laminate and / or veneer manufacturer to suit application. Face veneer and cuts as indicated on Drawings:
 - 1. Certified composite wood: No added urea-formaldehyde resins.
- C. Softwood Plywood: DOC PS 1.
- D. Medium Density Fiberboard (MDF): ANSI A208.2, Grade 130, made with binder containing no urea-formaldehyde resin.
- E. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea-formaldehyde resin.

2.02 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame

front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent respectively.
- B. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.
 1. For exposed lumber and plywood indicated to receive a stained or natural finish, mark back of each piece.
- C. Application: Where indicated.

2.03 PANELING

- A. Hardwood Veneer Plywood Paneling: Manufacturer's stock hardwood plywood panels complying with HPVA HP-1.
 1. Basis-of-Design Product: Timber Products Company, "Hardwood Plywood." Subject to compliance with requirements, provide product indicated or comparable product from a pre-approved manufacturer.
 - a. Roseburg Forest Products Company.
 - b. SJ Morse Company.
 - c. Timber Products Company.
 - d. Or pre-approved equal.
 2. Face Veneer Species and Cut: Rotary-cut white birch.
 3. Veneer Matching: Selected for similar color and grain.
 4. Thickness: 1/4 inch (6.4 mm).
 5. Core: 1/2 inch plywood or medium density plywood.
 6. Factory Finish: As indicated by manufacturer's designation.
 7. Finish: As selected by Architect from manufacturer's full range.

2.04 INTERIOR ALUMINUM MILLWORK TRIM

- A. Manufacturer: Fry Reglet Corporation, or pre-approved equal.
- B. Exposed Panel Edges: Extruded aluminum, finish as selected by Architect.
 1. Millwork Reveal F:
 - a. Acceptable product: Fry Reglet Number MWRF.
 - b. Characteristics:
 - 1) Description: Provides a straight, uniform reveal horizontally or vertically at the edge of panels.
 - 2) Material: Extruded aluminum, with clear anodized finish.
 - 3) Dimensions: As indicated on drawings.
 2. 4" Millwork Reveal Base:
 - a. Acceptable product: Fry Reglet Number MWRB.

b. Characteristics:

- 1) Description: Features an exposed 4" base flange that provides a straight, uniform base horizontally at the bottom of millwork panels.
- 2) Material: Extruded aluminum.
- 3) Dimensions: As indicated on drawings.

3. Millwork Post:

a. Acceptable product: Fry Reglet Number MWP.

b. Characteristics:

- 1) Description: provides a 1/4" thick, straight and uniform post horizontally or vertically between panels.
- 2) Material: Extruded aluminum.
- 3) Dimensions: As indicated on drawings.

2.05 MISCELLANEOUS MATERIALS

A. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.

1. Wood glue shall have a VOC content of 30 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)

B. Paneling Adhesive: Comply with paneling manufacturer's written instructions for adhesives.

1. Adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.01 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours unless longer conditioning is recommended by manufacturer.

3.02 INSTALLATION, GENERAL

A. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials.

1. Use concealed shims where necessary for alignment.
2. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
3. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
4. Install to tolerance of 1/8 inch in 96 inches (3 mm in 2438 mm) for level and plumb. Install adjoining interior finish carpentry with 1/32-inch (0.8-mm) maximum offset for flush installation and 1/16-inch (1.5-mm) maximum offset for reveal installation.

3.03 INTERIOR TRIM INSTALLATION

- A. Install metal trim per manufacturer's instructions.

3.04 PANELING INSTALLATION

- A. Plywood Paneling: Select and arrange panels on each wall to minimize noticeable variations in grain character and color between adjacent panels.
 - 1. Leave 1/4-inch (6-mm) gap to be covered with trim at top, bottom, and openings.
 - 2. Install with uniform tight joints between panels.
 - 3. Attach panels to supports with manufacturer's recommended panel adhesive and fasteners.
 - 4. Space fasteners and adhesive as recommended by panel manufacturer.
 - 5. Conceal fasteners to greatest practical extent.

END OF SECTION

SECTION 06 41 16

PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad architectural cabinets.
2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-clad architectural cabinets that are not concealed within other construction.

1.02 PREINSTALLATION MEETINGS

- ###### A. Preinstallation Conference: Conduct conference at Project site.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Apply AWI Quality Certification Program (QCP) label to Shop Drawings.

C. Samples: For each exposed product and for each color and texture specified.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and Installer.

B. Research reports.

C. Field quality control reports.

1.05 CLOSEOUT SUBMITTALS

A. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.06 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1. Manufacturer's Certification: Participant in AWI Quality Certification Program with licenses for all QCP scope items required for this project.

- B. Installer Qualifications: A subcontractor that employees skilled workers that are experienced in the installation of custom fabricated products.

PART 2 - PRODUCTS

2.01 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.
 - 1. Provide labels and certificates from AWI certification program indicating that woodwork complies with requirements of grades specified.
- B. Architectural Woodwork Standards Grade: Premium.
- C. Type of Construction: Frameless
- D. Door and Drawer-Front Style: Flush overlay.
 - 1. Reveal Dimension: 1/2 inch (13 mm).
- E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.
- F. Laminate Cladding for Exposed Surfaces:
 - 1. Horizontal Surfaces: Grade HGS.
 - 2. Postformed Surfaces: Grade HGP.
 - 3. Vertical Surfaces: Grade VGS.
 - 4. Edges: PVC edge banding, 3.0 mm thick, matching laminate in color, pattern, and finish.
 - 5. Pattern Direction: Vertically for doors and fixed panels, horizontally for drawer fronts.
- G. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.
- H. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
 - 1. Join subfronts, backs, and sides with glued dovetail joints.
- I. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. As indicated by laminate manufacturer's designations.
 - 2. Match Architect's sample.
 - a. Formica Sheet Laminate:
 - 1) **PL-1:** Neutral Twill - Texture 8826-58; matte finish.
 - 2) **PL-2:** Sarum Twill - Texture 8827-58; matte finish.

2.02 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
 - 1. Wood Moisture Content: 8 to 13 percent.
- B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
 - 1. Medium-Density Fiberboard (MDF): Grade 130.
 - 2. Particleboard: ANSI A208.1, Grade M-2.
 - 3. Straw-Based Particleboard: ANSI A208.1, Grade M-2, except for density.
 - 4. Softwood Plywood: DOC PS 1, medium-density overlay.
 - 5. Thermoset Decorative Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.03 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials that are acceptable to authorities having jurisdiction as determined by testing performed on identical products by a qualified testing agency.
 - 1. Use treated materials that comply with requirements of referenced quality standard. Do not use materials 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 qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

2.04 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 08 71 00 "Door Hardware."
- B. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, B01602, 135 degrees of opening.
- C. Back-Mounted Pulls: ANSI/BHMA A156.9, B02011.
- D. Wire Pulls: Back mounted, solid 5 inches (127 mm) long, 2-1/2 inches (63.5 mm) deep, and 5/16 inch (8 mm) in diameter.
- E. Adjustable Shelf Standards and Supports: ANSI/BHMA A156.9, B04071; with shelf rests, B04081.
- F. Shelf Rests: ANSI/BHMA A156.9, B04013; metal.
- G. Drawer Slides: ANSI/BHMA A156.9.

1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer.
 - a. Type: Full extension.
 - b. Material: Zinc-plated steel with polymer rollers.
 2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
 3. For drawers not more than 3 inches (75 mm) high and not more than 24 inches (600 mm) wide, provide Grade 1.
 4. For drawers more than 3 inches (75 mm) high, but not more than 6 inches (150 mm) high and not more than 24 inches (600 mm) wide, provide Grade 1.
 5. For drawers more than 6 inches (150 mm) high or more than 24 inches (600 mm) wide, provide Grade 1HD-200.
 6. For computer keyboard shelves, provide Grade 1HD-100.
 7. For trash bins not more than 20 inches (500 mm) high and 16 inches (400 mm) wide, provide Grade 1HD-100.
- H. Door Locks: ANSI/BHMA A156.11, E07121.
- I. Drawer Locks: ANSI/BHMA A156.11, E07041.
- J. Door and Drawer Silencers: ANSI/BHMA A156.16, L03011.
- K. Grommets for Cable Passage: 2-inch (51-mm) OD, molded-plastic grommets and matching plastic caps with slot for wire passage.
1. Color: Black.
- L. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for ANSI/BHMA finish number indicated.
1. Satin Chromium Plated: ANSI/BHMA 626 for brass or bronze base; ANSI/BHMA 652 for steel base.
 2. Bright Chromium Plated: ANSI/BHMA 625 for brass or bronze base; ANSI/BHMA 651 for steel base.
 3. Satin Stainless Steel: ANSI/BHMA 630.
- M. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.

2.05 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesive for Bonding Plastic Laminate: PVA. Do not use adhesives that contain urea formaldehyde.

2.06 FABRICATION

- A. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- B. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.
- B. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.
- C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.
- D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm) using concealed shims.
 - 1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
 - 2. Install cabinets without distortion so doors and drawers fit openings 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.
 - 3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches (400 mm) o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch (38-mm) penetration into wood framing, blocking, or hanging strips.

3.02 FIELD QUALITY CONTROL

- A. Inspections: Provide inspection of installed Work through AWI's Quality Certification Program certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.
 - 1. Inspection entity shall prepare and submit report of inspection.

END OF SECTION

SECTION 06 64 00
PLASTIC PANELING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes glass-fiber reinforced plastic (FRP) wall paneling and trim accessories.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For plastic paneling and trim accessories.

1.03 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.

PART 2 - PRODUCTS

2.01 PLASTIC SHEET PANELING

- A. General: Gelcoat-finished, glass-fiber reinforced plastic panels complying with ASTM D 5319.
- B. Plastic Sheet Paneling:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kemlite Company Inc.
 - b. Marlite.
 - c. Or approved equal.
 - 2. Nominal Thickness: Not less than 0.09-inch.
 - 3. Surface Finish: Smooth.
 - 4. Color: As selected by Architect from manufacturer's full range.

2.02 ACCESSORIES

- A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.
 - 1. Color: Match panels.
- B. Adhesive: As recommended by plastic paneling manufacturer.

- C. Sealant: Single-component, mildew-resistant, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 07 92 00 "Joint Sealants."

PART 3 - EXECUTION

3.01 PREPARATION

- A. Clean substrates of substances that could impair bond of adhesive, including oil, grease, dirt, and dust.
- B. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.
- C. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels.

3.02 INSTALLATION

- A. Install plastic paneling according to manufacturer's written instructions.
- B. Install panels in a full spread of adhesive.
- C. Install trim accessories with adhesive.
- D. Fill grooves in trim accessories with sealant before installing panels and bed inside corner trim in a bead of sealant.
- E. Maintain uniform space between panels and wall fixtures. Fill space with sealant.
- F. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION

SECTION 07 18 00
TRAFFIC COATINGS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes traffic coatings and pavement markings for the following applications:

1. Pedestrian traffic.
2. Vehicular traffic.

1.02 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.03 ACTION SUBMITTALS

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

1. Include installation instructions and details, material descriptions, dry or wet film thickness requirements, and finish.

- B. Shop Drawings: For traffic coatings.

1. Include details for treating substrate joints and cracks, flashings, deck penetrations, and other termination conditions that are not included in manufacturer's product data.

- C. Samples: For each exposed product and for each color and texture specified.

1.04 INFORMATIONAL SUBMITTALS

- A. Product certificates.

- B. Sample warranty.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.06 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace traffic coating that fails in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Material Compatibility: Provide primers; base coat, intermediate coat, and topcoat; and accessory materials that are compatible with one another and with substrate under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

2.02 TRAFFIC COATING

- A. Traffic Coating: Manufacturer's standard, traffic-bearing, seamless, high-solids-content, cold liquid-applied, elastomeric, skid-resistant, waterproof deck coating system with integral wearing surface for pedestrian traffic and vehicular traffic service condition; according to ASTM G154 or G155.

1. Manufacturers:

- a. Advanced Polymer Technology Corporation.
- b. Crossfield Products Corporation.
- c. Euclid Chemical Company (The); an RPM company.
- d. ITW Polymers Sealants North America, Inc. (Pacific Polymers).
- e. Pecora Corporation.
- f. Tremco Incorporated.
- g. Urethane Polymers International.
- h. Or preapproved equal.

- 2. Basis of Design Product: Pacific Polymers® Elasto-Deck 5000 H.T. Waterproof Polyurethane Coating System for Vehicular and Pedestrian Traffic, is liquid applied, seamless, slip resistant, polyurethane, waterproof deck coating system.

- a. Composition: Liquid-applied, single component, moisture-cured, polyurethane deck covering system. System consists of Elasto-Deck 5000 HT Base Coat and Intermediate Coat, and ElastoGlaze 6001AL-HT Top Coat sealer, and a primer, where necessary.
- b. Basic Uses: For waterproofing parking decks and concrete roof decks. Elasto-Deck 5000HT can be used on all decks where a skid-resistant, long lasting, wear-resistant surface is required.

2.03 APPLICATION

- A. Medium and Heavy Duty Decks:

- 1. Step 1: Elasto-Deck 5001HT shall be applied to the primed concrete at a rate of 64 square feet per gallon (1.57m²/liter) resulting in a film thickness of 25 mils (0.63 mm). Application must be made uniformly to avoid thin spots and care must be taken to avoid pinholes and repair them should they occur.
- 2. Step 2: Following an overnight cure, apply Elasto-Deck 5001HT at a rate of 100 square feet per gallon (2.5m²/liter) for a thickness of 16 mils (0.4 mm). It is preferable to use a heavy duty roller for even distribution.
- 3. Step 3: Immediately broadcast 1 gallon (3.785 liters) of 20 mesh Gillibrand Silver Sand, or equivalent, uniformly into the wet coating, per 100 sq. ft. (2.45m²/liter). Assure that the

coating is back rolled for even distribution of the sand. Do not broadcast to refusal. Allow to cure overnight.

4. Step 4: Repeat Steps 2 and 3, where needed, as advised by the manufacturer. Allow an overnight cure of Elasto-Deck 5001HT.
5. Step 5: Apply ElastoGlaze 6001AL-HT by roller, brush or spray at 150 sq. ft. per gallon (3.86 m²/liter) to equal 10 mils (0.25mm). Allow 72 hours for complete cure of the system.

2.04 TEMPERATURE CONSTRAINTS

- A. Minimum application temperature is 40°F (4°C) and rising and more than 5°F above dew point.
- B. Contact Technical Service when substrates are over 90°F (32°C) or under 40°F (4°C).
- C. Avoid application when inclement weather is present or imminent.
- D. Do not apply to damp, wet, or contaminated surfaces.

2.05 MAINTENANCE

- A. Since the topcoat is subject to staining by such foreign matter as nitrates, fertilizers, hard water, and other substances, it must be maintained. Refer to the Maintenance Manual for proper maintenance procedures. The manufacturer is not liable for staining caused by hard water deposits, nitrates, fertilizers and other foreign matter.

1. Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Clean and prepare substrates according to ASTM C1127 and manufacturer's written instructions to produce clean, dust-free, dry substrate for traffic-coating application.
 1. Application of coating indicates acceptance of surfaces and conditions.
- B. Mask adjoining surfaces not receiving traffic coatings to prevent overspray, spillage, leaking, and migration of coatings. Prevent traffic-coating materials from entering deck substrate penetrations and clogging weep holes and drains.
- C. Concrete Substrates: Mechanically abrade surface to a uniform profile acceptable to manufacturer, according to ASTM D4259. Do not acid etch.
 1. Remove grease, oil, paints, and other penetrating contaminants from concrete.
 2. Remove concrete fins, ridges, and other projections.
 3. Remove laitance, glaze, efflorescence, curing compounds, concrete hardeners, form-release agents, and other incompatible materials that might affect coating adhesion.
 4. Remove remaining loose material to provide a sound surface, and clean surfaces according to ASTM D4258.

3.02 TERMINATIONS AND PENETRATIONS

- A. Prepare vertical and horizontal surfaces at terminations and penetrations through traffic coatings and at expansion joints, drains, and sleeves according to ASTM C1127 and manufacturer's written instructions.
- B. Provide sealant cants at penetrations and at reinforced and nonreinforced, deck-to-wall butt joints.
- C. Terminate edges of deck-to-deck expansion joints with preparatory base-coat strip.
- D. Install sheet flashings at deck-to-wall expansion and dynamic joints, and bond to deck and wall substrates according to manufacturer's written recommendations.

3.03 JOINT AND CRACK TREATMENT

- A. Prepare, treat, rout, and fill joints and cracks in substrates according to ASTM C1127 and manufacturer's written recommendations. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D4258.
 - 1. Comply with recommendations in ASTM C1193 for joint-sealant installation.
- B. Apply reinforcing strip in traffic-coating system where recommended in writing by traffic-coating manufacturer.

3.04 TRAFFIC-COATING APPLICATION

- A. Apply traffic coating according to ASTM C1127 and manufacturer's written instructions.
- B. Apply coats of specified compositions for each type of traffic coating at locations as indicated on Drawings.
- C. Apply traffic coatings to prepared wall terminations and vertical surfaces to height indicated; omit aggregate on vertical surfaces.
- D. Cure traffic coatings.

3.05 PAVEMENT MARKINGS

- A. Do not apply pavement-marking paint for striping and other markings until layout, colors, and placement have been verified with Architect and traffic coating has cured.
- B. Sweep and clean surface to eliminate loose material and dust.
- C. Apply pavement-marking paint with mechanical equipment to produce markings of dimensions indicated with uniform straight edges. Apply at manufacturer's recommended rates for a minimum wet-film thickness of 15-mils (0.4-mm).

3.06 PROTECTING AND CLEANING

- A. Protect traffic coatings from damage and wear during remainder of construction period.

- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 07 21 00
THERMAL INSULATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Glass-fiber blanket.
 - 2. Sound attenuation batt insulation.

1.02 ACTION SUBMITTALS

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

1.03 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Research reports.

PART 2 - PRODUCTS

2.01 GLASS-FIBER BLANKET

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CertainTeed Corporation.
 - 2. Johns Manville.
 - 3. Knauf Insulation.
 - 4. Owens Corning.
 - 5. Thermafiber, Inc.
 - 6. Or pre-approved equal.
- B. Polypropylene-Scrim-Kraft-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type II (non-reflective faced), Class C (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier).
- C. Reinforced-Foil-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.
- D. Sound Attenuation Batt Insulation: Glass-Fiber Blanket Insulation: ASTM C 665, Type I (unfaced); Sound Transmission Class: STC 40 (minimum).

2.02 ACCESSORIES

- A. Insulation for Miscellaneous Voids:

1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.
 2. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.
- B. Insulation Anchors, Spindles, and Standoffs: As recommended by manufacturer.
- C. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to rain at any time.
- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.02 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 4. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
 5. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.
 - a. Interior Walls: Set units with facing placed as indicated on Drawings.
- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).
 2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

END OF SECTION

SECTION 07 71 29

MANUFACTURED ROOF EXPANSION JOINTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Flanged bellows-type roof expansion joints.
 - 2. Aluminum roof expansion joints.

1.02 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For roof expansion joints.
- C. Samples: For each exposed product and for each color specified.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification data.
- B. Product test reports.
- C. Sample warranty.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Installer of roofing membrane.

1.06 WARRANTY

- A. Special Warranty: Manufacturer and Installer agree to repair or replace roof expansion joints and components that leak, deteriorate beyond normal weathering, or otherwise fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace roof expansion joints that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Rating: Comply with ASTM E1966 or UL 2079; testing by a qualified testing agency to resist the spread of fire and to accommodate building thermal and seismic movements without impairing its ability to resist the passage of fire and hot gases. Identify products with appropriate markings of applicable testing agency.
1. Rating: Not less than 1-hour fire-resistance rating of the roof assembly.
 2. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.02 FLANGED BELLOWS-TYPE ROOF EXPANSION JOINTS

- A. Flanged Bellows-Type Roof Expansion Joint: Factory-fabricated, continuous, waterproof joint cover consisting of exposed membrane bellows laminated to flexible, closed-cell support foam, and secured along each edge to 3- to 4-inch (76- to 100-mm) wide metal flange.
1. Manufacturer's:
 - a. Architectural Art Manufacturing Inc.; a division of Pittcon Architectural Metals, LLC.
 - b. Balco, Inc.
 - c. C/S Group.
 - d. InPro Corporation (IPC).
 - e. Nystrom, Inc.
 - f. Watson Bowman Acme Corp.
 - g. Or approved equal.
 2. Source Limitations: Obtain flanged bellows-type roof expansion joints approved by roofing manufacturer and that are part of roofing membrane warranty.
 3. Bellows: EPDM flexible membrane, nominal 60 mils (1.5 mm) thick.
 4. Flanges: Galvanized steel, 0.022 inch (0.56 mm) thick.
 5. Corner, Intersection, and Transition Units: Provide factory-fabricated units for corner and joint intersections and horizontal and vertical transitions including those to other building expansion joints.
 6. Accessories: Provide splicing units, adhesives, and other components as recommended by roof-expansion-joint manufacturer for complete installation.
 7. Secondary Seal: Continuous, waterproof membrane within joint and attached to substrate on sides of joint below the primary bellows assembly.
 - a. Drain-Tube Assemblies: Equip secondary seal with drain tubes and seals to direct collected moisture to drain or to exterior-wall joint cover.
 - b. Thermal Insulation: Fill space above secondary seal with mineral-fiber blanket insulation; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84.
 8. Fire Barrier: Manufacturer's standard fire barrier for fire-resistance-rated expansion joint system.
- B. Materials:
1. Galvanized-Steel Sheet: ASTM A653/A653M, hot-dip zinc-coating designation G90 (Z275).

2. Copper Sheet: ASTM B370, cold-rolled copper sheet, H00 or H01 temper.
3. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.
4. Aluminum Sheet: ASTM B209 (ASTM B209M), mill finish, with temper to suit forming operations and performance required.
 - a. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious or preservative-treated wood materials.
5. EPDM Membrane: ASTM D4637/D4637M, type standard with manufacturer for application.
6. Neoprene Membrane: Neoprene sheet recommended by EPDM manufacturer for resistance to hydrocarbons, non-aromatic solvents, grease, and oil; and as standard with roof-expansion-joint manufacturer for application.
7. PVC Membrane: ASTM D4434/D4434M, type standard with manufacturer for application.

2.03 MISCELLANEOUS MATERIALS

- A. Adhesives: As recommended by roof-expansion-joint manufacturer.
- B. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to withstand design loads.
 1. Exposed Fasteners: Gasketed. Use screws with hex washer heads matching color of material being fastened.
- C. Mineral-Fiber Blanket: ASTM C665.
- D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Comply with manufacturer's written instructions for handling and installing roof expansion joints.
 1. Anchor roof expansion joints securely in place, with provisions for required movement. Use fasteners, protective coatings, sealants, and miscellaneous items as required to complete roof expansion joints.
 2. Install roof expansion joints true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
 3. Provide for linear thermal expansion of roof expansion joint materials.
- B. Directional Changes: Install factory-fabricated units at directional changes to provide continuous, uninterrupted, and watertight joints.
- C. Transitions to Other Expansion-Control Joint Assemblies: Coordinate installation of roof expansion joints with other exterior expansion-control joint assemblies specified in Section 07 95 13.16 "Exterior Expansion Joint Cover Assemblies" to result in watertight performance. Install factory-fabricated units at transitions between roof expansion joints and exterior expansion-control joint systems.
- D. Splices: Splice roof expansion joints to provide continuous, uninterrupted, and waterproof joints.

1. Install waterproof splices and prefabricated end dams to prevent leakage of secondary-seal membrane.
- E. Fire Barrier: Install fire barrier as required by manufacturer to provide continuous, uninterrupted fire resistance throughout length of roof expansion joint, including transitions and end joints.
- F. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

END OF SECTION

SECTION 07 91 06

DECK AND PARKING JOINT SEALANTS

PART 1 - GENERAL

1.01 PREINSTALLATION MEETINGS

A. Pre-Installation Conference:

1. Convene at Project site 2 weeks prior to beginning work of this Section.
2. Attendance: Architect, Contractor, joint seal installer, and related trades.
3. Review and discuss:
 - a. Joint seal manufacturer's requirements, project conditions, substrate requirements allowable structural movement at joints, and protection of completed work.
 - b. Transitions in plane and direction, and requirement for continuity of seal through watertight transitions from wall expansion joint to other interfacing expansion joint systems at adjacent construction.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
 - a. Indicate joint locations, dimensions, and adjacent construction'
 - b. Provide details for transitions in plane and direction for continuity of seal through watertight transitions from wall expansion joint to other interfacing expansion joint systems at adjacent construction.
2. Product Data: Material description and application instructions.
3. Samples:
 - a. Minimum 2 x 2 inch joint seal samples showing available colors.
 - b. Minimum 6 inch long samples of each joint seal.

B. Informational Submittals:

1. Manufacturer's certification that:
 - a. Products are capable of withstanding temperature of 150 degrees F (65 degrees C) for 3 hours while compressed to minimum of movement capability dimension without evidence of bleeding of impregnation medium from material.
 - b. Same material after heat stability test and after cooling to room temperature will self-expand to maximum of movement capability dimension within 24 hours at 68 degrees F (20 degrees C).

C. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.

3. Joint-sealant formulation.
4. Joint-sealant color.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Minimum 10 years documented experience in production of specified materials.
2. Certified to ISO 9001 and 14001.

B. Installer Qualifications: Minimum 2 years documented experience in work of this Section.

1.04 DELIVERY, STORAGE AND HANDLING

A. In accordance with manufacturer's instructions.

1.05 WARRANTY

A. Special Warranty: Installer agrees to repair or replace preformed joint seals that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

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

1. Dow Chemical Corporation.
2. GE Construction Sealants; Momentive Performance Materials, Inc.
3. Pecora Corporation.
4. Sika Corporation; Joint Sealants.
5. Or pre-approved equal.

B. Basis of design product by Sika Emseal.

2.02 MATERIALS

A. Deck and Parking Joint Seal:

1. Source: DSM-DS System by Sika Emseal.
2. Description: Precompressed, silicone coated and acrylic impregnated foam hybrid installed into field-applied epoxy adhesive, with dual-faced silicone bellows and silicone sealant band on watertight side.

3. Form: Precompressed to less than nominal material size for installation into designed joint size equal to material nominal size.
4. Movement capability: Plus or minus 50 percent, total 100 percent; pass ASTM E1399.
5. Color: As selected from full color range.
6. Silicone: Field applied sealant band at face of seal to substrate interface, furnished by joint seal manufacturer; same material and color as factory coating.
 - a. Abrasion resistance: Maximum 1 percent weight loss, tested to ASTM D4060.
 - b. Fuel resistance: Pass ASTM C719 and ASTM C1135.

2.03 JOINT-SEALANT BACKING

- A. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.04 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.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Surface Cleaning of Joints: remove loose and foreign matter that could impair adhesion or performance.
 1. Remove laitance and form-release agents from concrete.
 2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

3.02 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with ASTM C1193 and joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

- B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
- C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 1. Provide concave joint profile per Figure 8A in ASTM C1193 unless otherwise indicated.

3.03 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
 - 1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.
 - b. Perform one test for each 1000 feet (300 m) of joint length thereafter or one test per each floor per elevation.
 - 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.
- B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

END OF SECTION

SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Nonstaining silicone joint sealants.
 - 2. Mildew-resistant joint sealants.
 - 3. Latex joint sealants.
- B. Related Requirements:
 - 1. Refer to Section 07 92 19 - Acoustical Joint Sealants.

1.02 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.03 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples: For each kind and color of joint sealant required.
- C. Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.

1.04 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Preconstruction laboratory test reports.
- C. Preconstruction field-adhesion-test reports.
- D. Field-adhesion-test reports.
- E. Sample warranties.

1.05 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C1021 to conduct the testing indicated.

1.06 PRECONSTRUCTION TESTING

- A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
 - 1. Adhesion Testing: Use ASTM C794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - 2. Compatibility Testing: Use ASTM C1087 to determine sealant compatibility when in contact with glazing and gasket materials.
 - 3. Stain Testing: Use ASTM C1248 to determine stain potential of sealant when in contact with masonry substrates.
- B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates. Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.

1.07 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 JOINT SEALANTS, GENERAL

- A. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.02 NONSTAINING SILICONE JOINT SEALANTS

- A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
 - 1. Dow Chemical Corporation.
 - 2. GE Construction Sealants; Momentive Performance Materials, Inc.
 - 3. Pecora Corporation.
 - 4. Sika Corporation; Joint Sealants.
 - 5. Or pre-approved equal.
- B. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C1248.
- C. Silicone, Nonstaining, S, NS, 100/50, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.

- D. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.
- E. Silicone, Nonstaining, S, NS, 100/50, T, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses T and NT.
- F. Silicone, Nonstaining, M, NS, 50, NT: Nonstaining, multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type M, Grade NS, Class 50, Use NT.

2.03 MILDEW-RESISTANT JOINT SEALANTS

- A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
 - 1. Dow Chemical Corporation.
 - 2. GE Construction Sealants; Momentive Performance Materials, Inc.
 - 3. Pecora Corporation.
 - 4. Tremco Incorporated.
 - 5. Or pre-approved equal.
- B. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- C. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
- D. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.

2.04 JOINT-SEALANT BACKING

- A. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.05 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.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove laitance and form-release agents from concrete.
 - 2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

3.02 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with ASTM C1193 and joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
- C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 1. Provide concave joint profile per Figure 8A in ASTM C1193 unless otherwise indicated.

3.03 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
 - 1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.
 - b. Perform one test for each 1000 feet (300 m) of joint length thereafter or one test per each floor per elevation.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.

- B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.04 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.

1. Joint Locations:

- a. Isolation joints in cast-in-place concrete slabs.
- b. Control and expansion joints in stone flooring.
- c. Control and expansion joints in brick flooring.
- d. Control and expansion joints in tile flooring.
- e. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, S, P, 25, T, NT.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

- B. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

- a. Control and expansion joints on exposed interior surfaces of exterior walls.
- b. Tile control and expansion joints.
- c. Vertical joints on exposed surfaces of unit masonry and concrete walls and partitions.
- d. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, S, NS, 25, NT.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

- C. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.

1. Joint Locations:

- a. Perimeter joints between interior wall surfaces and frames of interior doors.
- b. Other joints as indicated on Drawings.

2. Joint Sealant: Acrylic latex.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

- D. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

- a. Joints between plumbing fixtures and adjoining walls, floors, and counters.

- b. Tile control and expansion joints where indicated.
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Joint-Sealant Application: Concealed mastics.
- 1. Joint Locations:
 - a. Aluminum thresholds.
 - b. Sill plates.
 - c. Other joints as indicated on Drawings.
 - 2. Joint Sealant: Butyl-rubber based.
 - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION

SECTION 07 92 19

ACOUSTICAL JOINT SEALANTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Acoustical joint sealants.
 - 2. Sound and vibration control components.

1.02 ACTION SUBMITTALS

- A. Product Data: For each acoustical joint sealant and installation instructions.
- B. Samples: For each kind and color of acoustical joint sealant required.
- C. Acoustical-Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.

1.03 INFORMATIONAL SUBMITTALS

- A. Product ASTM test reports from independent laboratories with NVLAP certification of standards compliance, documenting product performance specified for:
 - 1. Acoustical properties.
 - 2. Physical properties.
 - 3. Fire-related properties.
- B. Sample warranties.

1.04 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace acoustical 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.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Provide acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies according to ASTM E90.

2.02 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C834.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Everkem Diversified Products, Inc.
 - b. GE Construction Sealants; Momentive Performance Materials, Inc.
 - c. Hilti, Inc.
 - d. Pecora Corporation.
 - e. Tremco Incorporated.
 - f. USG Corporation.
 - g. Or pre-approved equal.
 - 2. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.
- B. Primer: Material recommended by acoustical-joint-sealant manufacturer where required for adhesion of sealant to joint substrates.
- C. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.
- D. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

2.03 SOUND AND VIBRATION CONTROL COMPONENTS

- A. Basis-of-Design Product: The Green Glue Company, Inc., a part of Saint-Gobain; "Green Glue Noiseproofing Sealant."
- B. Physical Properties:
 - 1. Active Content: 68 percent +/-5 percent.
 - 2. Working Time: 30 minutes at room temperature.
 - 3. Viscosity: Light paste; 65,000 cpd.
 - 4. Color: Green.
 - 5. VOC: >2 g/l.
 - 6. Flash Point: >200 degrees F.
 - 7. Application Temperature: 40 to 90 degrees F.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing acoustical joint sealants to comply with joint-sealant manufacturer's written instructions.
- B. Joint Priming: Prime joint substrates where recommended by acoustical-joint-sealant manufacturer.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

3.02 INSTALLATION OF ACOUSTICAL JOINT SEALANTS

- A. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.
- B. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C919, ASTM C1193, and manufacturer's written recommendations for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.
- C. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

3.03 INSTALLATION OF SOUND AND VIBRATION CONTROL COMPONENTS

- A. Construct standard wall framing and install first layer of gypsum board.
- B. Remove any dust or debris from the gypsum board surfaces to be glued.
- C. Apply prescribed quantity of Green Glue in a random pattern to the back of the second layer of gypsum board.
- D. Assemble the coated gypsum board layer to the first layer and screw into place.
 - 1. Use standard gypsum board screws.
 - 2. Screw the second layer into the wall studs, spacing according to local building code.
- E. Seal the assembly with caulk or sealant.
 - 1. Seal the intersection of the wall and floor.
 - 2. Seal any gaps between walls and ceiling.
 - 3. Seal the electrical boxes.

END OF SECTION

SECTION 07 95 13.16

EXTERIOR EXPANSION JOINT COVER ASSEMBLIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes exterior building expansion joint cover assemblies.
- B. Related Requirements:
 - 1. Section 07 71 29 "Manufactured Roof Expansion Joints" for factory-fabricated roof expansion joint cover assemblies.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each expansion joint cover assembly.
 - 1. Include plans, elevations, sections, details, splices, block-out requirement, attachments to other work, and line diagrams and a tabular schedule of expansion joint cover assemblies.
- C. Samples: For each exposed expansion joint cover assembly and for each color and texture specified.

PART 2 - PRODUCTS

2.01 ASSEMBLY DESCRIPTION

- A. Furnish units in longest practicable lengths to minimize field splicing.
- B. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion joint cover assemblies.

2.02 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Expansion joint cover assemblies shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Fire-Resistance Ratings: Provide expansion joint cover assemblies with fire barriers identical to those of systems tested for fire resistance according to UL 2079 or ASTM E1966 by a qualified testing agency.
 - 1. Hose Stream Test: Wall-to-wall and wall-to-soffit assemblies shall be subjected to hose stream testing.
- C. Expansion Joint Design Criteria:

1. Type of Movement: Thermal.
 - a. Nominal Joint Width: As indicated on Drawings.
 - b. Minimum Joint Width: As indicated on Drawings.
 - c. Maximum Joint Width: As indicated on Drawings.
2. Type of Movement: Seismic.
 - a. Joint Movement: As indicated on Drawings.

2.03 EXTERIOR EXPANSION JOINT COVERS

- A. Exterior Metal-Plate Joint Cover: Assembly consisting of sliding metal cover plate in continuous contact with gaskets mounted on metal frames fixed to sides of joint gap.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Basis-of-Design Product: Emseal, a product of Sika Corporation.
 - b. Architectural Art Manufacturing Inc.; a division of Pittcon Architectural Metals, LLC.
 - c. Balco, Inc.
 - d. C/S Group.
 - e. InPro Corporation (IPC).
 - f. Nystrom, Inc.
 - g. Watson Bowman Acme Corp.
 - h. Or approved equal.
 2. Product: Emseal SJS-Seismic Joint System (**Alternate #2**).
 - a. Joint Sizes: For mean-temperature, structural-slab, joint sizes from 2-inch (50mm) up to 16-inch (400mm).
 - b. Movement Capacity: 100% (+50% and -50%) of nominal material size.
 - c. Coverplates: Standard coverplate is 3/8-inch (10mm) shot-blasted aluminum or stainless steel.
 - d. Coverplate thicknesses can be customized to suit load and traffic expectations.
 3. Fire-Resistance Rating: Not less than one or two hours.
 4. Exposed Metal:
 - a. Aluminum: Mill, Clear anodic, Class I, or Color anodic, Class I.
 - 1) Color: As selected by Architect from full range of industry colors and color densities.

2.04 MATERIALS

- A. Aluminum: ASTM B221 (ASTM B221M), Alloy 6063-T5 for extrusions; ASTM B209 (ASTM B209M), Alloy 6061-T6 for sheet and plate.
- B. Elastomeric Seals: Manufacturer's standard preformed elastomeric membranes or extrusions to be installed in metal frames.

- C. Fire Barriers: Any material or material combination, to comply with performance criteria for required fire-resistance rating.
- D. Moisture Barrier: Manufacturer's standard, flexible elastomeric material.

2.05 ALUMINUM FINISHES

- A. Mill finish.
- B. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
- C. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

2.06 ACCESSORIES

- A. Moisture Barriers: Manufacturer's standard moisture barrier consisting of a continuous, waterproof membrane within joint and attached to substrate on sides of joint.
 - 1. Provide where indicated on Drawings.
- B. Manufacturer's standard attachment devices, as indicated or required for complete installations.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Prepare substrates according to expansion joint cover assembly manufacturer's written instructions.
- B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion joint cover assemblies. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion joint cover assemblies.
- C. Comply with manufacturer's written instructions for storing, handling, and installing expansion joint cover assemblies and materials unless more stringent requirements are indicated.
- D. Metal Frames: Perform cutting, drilling, and fitting required to install expansion joint cover assemblies.
 - 1. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
 - 2. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation.
 - 3. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
 - 4. Install frames in continuous contact with adjacent surfaces.
 - a. Shimming is not permitted.
 - 5. Locate anchors at interval recommended by manufacturer, but not less than 3 inches (75 mm) from each end and not more than 24 inches (600 mm) o.c.

- E. Seals: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.
 - 1. Provide in continuous lengths for straight sections.
 - 2. Seal transitions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
 - 3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.
- F. Install with hairline mitered corners where expansion joint cover assemblies change direction or abut other materials.
- G. Terminate exposed ends of expansion joint cover assemblies with field- or factory-fabricated termination devices.
- H. Fire-Resistance-Rated Assemblies: Coordinate installation of expansion joint cover assembly materials and associated work so complete assemblies comply with performance requirements.
 - 1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.
- I. Moisture Barrier Drainage: If indicated, provide drainage fitting and connect to drains.
- J. Transition to Roof Expansion Joint Covers: Coordinate installation of exterior wall and soffit expansion joint covers with roof expansion joint covers specified in Section 07 71 29 "Manufactured Roof Expansion Joints." Install factory-fabricated units at transition between exterior walls and roof expansion joint cover assemblies.

3.02 PROTECTION

- A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.
- B. Protect the installation from damage by work of other Sections.

END OF SECTION

SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes:
 - 1. Interior standard steel doors and frames.
 - 2. Exterior heavy duty steel doors and frames.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door type.
 - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
- C. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.04 INFORMATIONAL SUBMITTALS

- A. Product test reports.

1.05 CLOSEOUT SUBMITTALS

- A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.06 QUALITY ASSURANCE

- A. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies shall meet the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:
 - 1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

- B. Egress Door Inspector Qualifications: Inspector for field quality control inspections of egress door assemblies shall meet the qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ceco Door Products; an ASSA ABLOY Group company.
 2. Curries Company; an ASSA ABLOY Group company.
 3. Republic Doors and Frames; an Allegion company.
 4. Steelcraft; an Allegion company.
 5. Or pre-approved equal.

2.02 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated on Drawings, based on testing at positive pressure according to NFPA 252 or UL 10C.
1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
 2. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
- B. Fire-Rated, Borrowed-Lite Assemblies: Assemblies complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.03 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Standard-Duty Doors and Frames: ANSI/SDI A250.8, Level 1; ANSI/SDI A250.4, Level C. At locations indicated in the Door and Frame Schedule.
1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4-inch (44.5-mm).
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.032-inch (0.8-mm).
 - d. Edge Construction: Model 2, Seamless.

- e. Core: Manufacturer's standard.
 - f. Fire-Rated Core: Manufacturer's standard vertical steel stiffener core for fire-rated and temperature-rise-rated doors.
 - 2. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.042-inch (1.0-mm).
 - b. Construction: Face welded.
- C. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B. At locations indicated in the Door and Frame Schedule.
- 1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4-inch (44.5-mm).
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.042-inch (1.0-mm).
 - d. Edge Construction: Model 2, Seamless.
 - e. Core: Manufacturer's standard.
 - f. Fire-Rated Core: Manufacturer's standard vertical steel stiffener core for fire-rated and temperature-rise-rated doors.
 - 2. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053-inch (1.3-mm).
 - b. Frames: Fabricated from same thickness material as adjacent door frame.
 - c. Construction: Face welded.

2.04 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
 - 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24-inch (610-mm) of frame height above 7-feet (2.1-m).
 - 3. Postinstalled Expansion Anchor: Minimum 3/8-inch (9.5-mm) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- C. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

2.05 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.
- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- F. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

2.06 FABRICATION

- A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4-inch (19-mm) beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
- B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
 - 1. Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding, or by rigid mechanical anchors.
 - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to ANSI/SDI A250.6, the Door Hardware Schedule, and templates.
 - 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 - 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

2.07 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.02 INSTALLATION

- A. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
 - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
 - 2. Fire-Rated Openings: Install frames according to NFPA 80.
 - 3. Floor Anchors: Secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 - 4. Solidly pack mineral-fiber insulation inside frames.
 - 5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
 - 6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 - 7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
 - a. Squareness: Plus or minus 1/16-inch (1.6-mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16-inch (1.6-mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16-inch (1.6-mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16-inch (1.6-mm), measured at jambs at floor.
- B. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
 - 1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.
 - 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 - 3. Smoke-Control Doors: Install doors according to NFPA 105.

3.03 FIELD QUALITY CONTROL

- A. Inspection Agency: Owner will engage a qualified inspector to perform inspections and to furnish reports to Architect.
- B. Inspections:
 - 1. Fire-Rated Door Inspections: Inspect each fire-rated door according to NFPA 80, Section 5.2.
 - 2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements according to NFPA 101, Section 7.2.1.15.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.04 REPAIR

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- C. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION

SECTION 08 14 16

FLUSH WOOD DOORS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Five-ply flush wood veneer-faced doors for transparent finish.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; STC rating of each door; construction details not covered in Product Data; and the following:

1. Door schedule indicating door location, type, size, fire protection rating, and swing.
2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
3. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
4. Dimensions and locations of blocking for hardware attachment.
5. Clearances and undercuts.
6. Requirements for veneer matching.
7. Apply AWI Quality Certification Program label to Shop Drawings.

C. Samples: For factory-finished doors.

D. Architect to approve color.

1.03 INFORMATIONAL SUBMITTALS

A. Qualification Data: For door inspector.

1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.

B. Field quality-control reports.

1.04 CLOSEOUT SUBMITTALS

A. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

B. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.05 QUALITY ASSURANCE

- A. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.
- B. Fire-Rated Door Inspector Qualifications: Inspector for field quality-control inspections of fire-rated door assemblies shall comply with qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:
 - 1. DHI's Fire and Egress Door Assembly Inspector (FDAI) certification.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Wood Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings and temperature-rise limits indicated on Drawings, based on testing at positive pressure in accordance with UL 10C or NFPA 252.
 - 1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
 - 2. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
- B. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.

2.02 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with "Architectural Woodwork Standards."
 - 1. Provide labels from AWI certification program indicating that doors comply with requirements of grades specified.

2.03 SOLID-CORE, FIVE-PLY FLUSH WOOD VENEER-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Doors:
 - 1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
 - a. Eggers Industries.
 - b. Graham Wood Doors; a Masonite Architectural company.
 - c. Mohawk Doors; a Masonite Architectural company.
 - d. Oshkosh Door Company.
 - e. VT Industries, Inc.
 - f. Or pre-approved equal.

2. Performance Grade:
 - a. ANSI/WDMA I.S. 1A Heavy Duty unless otherwise indicated on Drawings.
3. Architectural Woodwork Standards Grade: Premium.
4. Faces: Single-ply wood veneer not less than 1/50 inch (0.508 mm) thick.
 - a. Species: Select white maple.
 - b. Cut: Quarter sliced.
 - c. Match between Veneer Leaves: Book match.
 - d. Assembly of Veneer Leaves on Door Faces: Center-balance match.
 - e. Pair and Set Match: Provide for doors hung in same opening.
 - f. Room Match: Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 10 feet (3 m) or more.
 - g. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
 - h. Blueprint Match: Where indicated, provide doors with faces produced from same flitches as adjacent wood paneling and arranged to provide blueprint match with wood paneling. Comply with requirements in Section 064216 "Flush Wood Paneling."
5. Exposed Vertical Edges: Same species as faces - Architectural Woodwork Standards edge Type A.
 - a. Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.
 - b. Fire-Rated Pairs of Doors: Provide formed-steel edges and astragals with intumescent seals.
 - 1) Finish steel edges and astragals to match door hardware (locksets or exit devices).
 - c. Mineral-Core Doors: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
 - 1) Screw-Holding Capability: 475 lbf (2110 N) in accordance with WDMA T.M. 10.
6. Core for Non-Fire-Rated Doors:
 - a. Glued wood stave.
 - b. WDMA I.S. 10 structural composite lumber.
 - 1) Screw Withdrawal, Face: 475 lb (2110 N).
 - 2) Screw Withdrawal, Edge: 475 lb (2110 N).
 - c. Either glued wood stave or WDMA I.S. 10 structural composite lumber.
7. Core for Fire-Rated Doors: As required to achieve fire-protection rating indicated on Drawings.

- a. Blocking for Mineral-Core Doors: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated on Drawings as follows:
 - 1) 5-inch (125-mm) top-rail blocking.
 - 2) 5-inch (125-mm) bottom-rail blocking, in doors indicated to have protection plates.
 - 3) 5-inch (125-mm) midrail blocking, in doors indicated to have armor plates.
 - 4) 4-1/2-by-10-inch (114-by-250-mm) lock blocks, in doors indicated to have exit devices.
 - 8. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.
 - B. Glazing: Refer to Section 08 80 00 - Glazing.
- 2.04 FABRICATION
 - A. Factory fit doors to suit frame-opening sizes indicated.
 - 1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 - 2. Comply with NFPA 80 requirements for fire-rated doors.
 - B. Factory machine doors for hardware that is not surface applied.
 - 1. Locate hardware to comply with DHI-WDHS-3.
 - 2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
 - 3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
 - 4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.
 - 5. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
- 2.05 FACTORY FINISHING
 - A. Comply with referenced quality standard for factory finishing.
 - 1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 - 2. Finish faces, all four edges, edges of cutouts, and mortises.
 - 3. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
 - B. Factory finish doors that are indicated on Drawings to receive transparent finish.
 - C. Factory finish doors where indicated in schedules or on Drawings as factory finished.
 - D. Transparent Finish:
 - 1. Architectural Woodwork Standards Grade: Premium.

2. Finish: Architectural Woodwork Standards System-5, Varnish, Conversion, or preapproved equal.
3. Staining: As selected by Architect from manufacturer's full range.
4. Effect: Semifilled finish, produced by applying an additional finish coat to partially fill the wood pores.
5. Sheen: Satin.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Hardware: For installation, see Section 08 71 00 "Door Hardware."
- B. Install doors and frames to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
- C. Install frames level, plumb, true, and straight.
 1. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8-inch in 96-inch (3.2-mm in 2400-mm).
 2. Install fire-rated doors and frames in accordance with NFPA 80.
 3. Install smoke- and draft-control doors in accordance with NFPA 105.
- D. Job-Fitted Doors:
 1. Align and fit doors in frames with uniform clearances and bevels as indicated below.
 - a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.
 2. Machine doors for hardware.
 3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 4. Clearances:
 - a. Provide 1/8-inch (3.2-mm) at heads, jambs, and between pairs of doors.
 - b. Provide 1/8-inch (3.2-mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
 - c. Where threshold is shown or scheduled, provide 1/4-inch (6.4-mm) from bottom of door to top of threshold unless otherwise indicated.
 - d. Comply with NFPA 80 for fire-rated doors.
 5. Bevel non-fire-rated doors 1/8-inch in 2-inch (3-1/2 degrees) at lock and hinge edges.
 6. Bevel fire-rated doors 1/8-inch in 2-inch (3-1/2 degrees) at lock edge; trim stiles and rails only to extent permitted by labeling agency.
- E. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- F. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.02 FIELD QUALITY CONTROL

- A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.
- B. Inspections:
 - 1. Provide inspection of installed Work through AWI's Quality Certification Program, certifying that wood doors and frames, including installation, comply with requirements of AWI/AWMCA/WI's "Architectural Woodwork Standards" for the specified grade.
 - 2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
 - 3. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.03 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION

SECTION 08 31 13
ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes access doors and frames for walls and ceilings.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type of access door and frame and for each finish specified.
- C. Product Schedule: For access doors and frames. Use same designations indicated on Drawings.

1.03 CLOSEOUT SUBMITTALS

- A. Record Documents: For fire-rated doors, list of applicable room name and number in which access door is located.

1.04 QUALITY ASSURANCE

- A. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies shall meet the qualifications set forth in NFPA 80, section 5.2.3.1 and the following:
 - 1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAl) certification.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, according to NFPA 252 or UL 10B.

2.02 ACCESS DOORS AND FRAMES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Babcock-Davis.
 - 2. JL. Industries, Inc.; Div. of Activar Construction Products Group.
 - 3. Larsen's Manufacturing Company.
 - 4. Milcor; a Hart & Cooley company.
 - 5. Nystrom, Inc.

6. Or pre-approved equal.

B. Flush Access Doors with Exposed Flanges:

1. Description: Face of door flush with frame, with exposed flange and concealed hinge.
2. Locations: Wall.
3. Uncoated Steel Sheet for Door: Nominal 0.060-inch (1.52-mm), 16 gage, factory finished.
4. Frame Material: Same material, thickness, and finish as door.
5. Latch and Lock: Cam latch, screwdriver operated.

2.03 FIRE-RATED ACCESS DOORS AND FRAMES

A. Fire-Rated, Flush Access Doors with Exposed Flanges:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Babcock-Davis.
 - b. J.L. Industries, Inc.; Div. of Activar Construction Products Group.
 - c. Larsen's Manufacturing Company.
 - d. Milcor; a Hart & Cooley brand.
 - e. Nystrom, Inc.
 - f. Or pre-approved equal.
2. Description: Door face flush with frame, uninsulated; with exposed flange, self-closing door, and concealed hinge.
3. Locations: Wall.
4. Fire-Resistance Rating: Not less than that of adjacent construction.
5. Uncoated Steel Sheet for Door: Nominal 0.036-inch (0.91-mm), 20 gage factory finished.
6. Frame Material: Same material, thickness, and finish as door.
7. Latch and Lock: Self-latching door hardware, operated by key.

2.04 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.
- C. Frame Anchors: Same material as door face.
- D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.05 FABRICATION

- A. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

- B. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
- C. Latch and Lock Hardware:
 - 1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
 - 2. Keys: Furnish two keys per lock and key all locks alike.

2.06 FINISHES

- A. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Factory Finished: Apply manufacturer's standard baked-enamel or powder-coat finish immediately after cleaning and pretreating, with minimum dry-film thickness of 1 mil (0.025 mm) for topcoat.
 - a. Color: As selected by Architect from full range of industry colors.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Adjust doors and hardware, after installation, for proper operation.

3.02 FIELD QUALITY CONTROL

- A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.
- B. Inspections:
 - 1. Fire-Rated Door Inspections: Inspect each fire-rated access door in accordance with NFPA 80, section 5.2.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- E. Prepare and submit separate inspection report for each fire-rated access door indicating compliance with each item listed in NFPA 80 and NFPA 101.

END OF SECTION

SECTION 08 41 13

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Exterior storefront framing.
 - 2. Exterior manual-swing entrance doors.

1.02 PREINSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.
 - 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
 - 2. Include full-size isometric details of each vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:
 - a. Joinery, including concealed welds.
 - b. Anchorage.
 - c. Expansion provisions.
 - d. Glazing.
 - e. Flashing and drainage.
 - 3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
- C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- D. Delegated-Design Submittal: For aluminum-framed entrances and storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.

1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront.
- C. Sample Warranties: For special warranties.
- 1.05 CLOSEOUT SUBMITTALS
 - A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.
- 1.06 QUALITY ASSURANCE
 - A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
 - B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
- 1.07 WARRANTY
 - A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration created by wind and thermal and structural movements.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - d. Water penetration through fixed glazing and framing areas.
 - e. Failure of operating components.
 2. Warranty Period: 10 years from date of Substantial Completion.
 - B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.

B. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.

C. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.
 - a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.
3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:
 - a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 11 feet 8-1/4 inches (3.6 m) or 1/175 times span, for spans less than 11 feet 8-1/4 inches (3.6 m).

D. Structural: Test according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

E. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:

1. Entrance Doors:
 - a. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. (2.54 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).

F. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).

- G. Water Penetration under Dynamic Pressure: Test according to AAMA 501.1 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
 2. Maximum Water Leakage: According to AAMA 501.1. Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.
- H. Seismic Performance: Aluminum-framed entrances and storefronts shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. Seismic Drift Causing Glass Fallout: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.6 at design displacement.
 2. Vertical Inter-story Movement: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.7 at design displacement.
- I. Energy Performance: Certify and label energy performance according to NFRC as follows:
1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.45 Btu/sq. ft. x h x deg F (2.55 W/sq. m x K) as determined according to NFRC 100.
 2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.40 as determined according to NFRC 200.
 3. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 35 as determined according to NFRC 500.
- J. Noise Reduction: Test according to ASTM E 90, with ratings determined by ASTM E 1332, as follows:
1. Outdoor-Indoor Transmission Class: Minimum 26.
- K. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
 2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
 - a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F (82 deg C).
 - b. Low Exterior Ambient-Air Temperature: 0 deg F (minus 18 deg C).
 - c. Interior Ambient-Air Temperature: 75 deg F (24 deg C).
- L. Structural-Sealant Joints:
1. Designed to carry gravity loads of glazing.
 2. Designed to produce tensile or shear stress of less than 20 psi (138 kPa).
- M. Structural Sealant: Capable of withstanding tensile and shear stresses imposed by structural-sealant-glazed storefront system without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.

1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate because sealant-to-substrate bond strength exceeds sealant's internal strength.

2.02 MANUFACTURERS

- A. Basis-of-Design Product: Arcadia MS362T Series Medium Stile Swinging Doors, or comparable product by one of the following:
1. Arcadia, Inc.
 2. EFCO Corporation.
 3. Kawneer North America.
 4. Pittco Architectural Metals, Inc.
 5. Tubelite.
 6. United States Aluminum; a C.R. Laurence Company.
 7. YKK AP America Inc.
- B. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

2.03 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
1. Door Construction: 1-3/4-inch (44.5-mm) overall thickness, with minimum 0.125-inch (3.2-mm) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated, and fillet welded or that incorporate concealed tie rods.
 - a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.
 2. Door Design: As indicated.
 3. Glazing Stops and Gaskets: Beveled, snap on, extruded-aluminum stops and pre-formed gaskets.
 - a. Provide non-removable glazing stops on outside of door.
- B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Construction: Thermally improved.
 2. Glazing System: Retained mechanically with gaskets on four sides.
 3. Glazing Plane: Front.
 4. Finish: Clear anodic finish.
 5. Fabrication Method: Field-fabricated stick system.
- C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with non-staining, nonferrous shims for aligning system components.

E. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - a. Sheet and Plate: ASTM B 209 (ASTM B 209M).
 - b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
 - c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
 - d. Structural Profiles: ASTM B 308/B 308M.
2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.
 - a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 - b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
 - c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

F. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

G. Glazing: Comply with Section 08 80 00 "Glazing."

H. Finish: Match adjacent aluminum-framed entrances and storefront finish.

2.04 ENTRANCE DOOR HARDWARE

A. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule for each entrance door to comply with requirements in this Section.

1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
3. Opening-Force Requirements:
 - a. Egress Doors: Not more than 15 lbf (67 N) to release the latch and not more than 30 lbf (133 N) to set the door in motion and not more than 15 lbf (67 N) to open the door to its minimum required width.
 - b. Accessible Interior Doors: Not more than 5 lbf (22.2 N) to fully open door.

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in "Entrance Door Hardware Sets" Article.
2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.

- C. Butt Hinges: BHMA A156.1, Grade 1, radius corner.
 - 1. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while entrance door is closed.
 - 2. Exterior Hinges: Stainless steel, with stainless-steel pin.
 - 3. Quantities:
 - a. For doors up to 87 inches (2210 mm)] high, provide three hinges per leaf.
 - b. For doors more than 87 and up to 120 inches (2210 and up to 3048 mm high, provide four hinges per leaf.
- D. Mortise Auxiliary Locks: BHMA A156.5, Grade 1.
- E. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
- F. Cylinders: As specified in Section 08 71 00 "Door Hardware."
 - 1. Keying: Master key system. Permanently inscribe each key with a visual key control number and include notation "DO NOT DUPLICATE" to be furnished by Owner.
- G. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.
- H. Operating Trim: BHMA A156.6.
- I. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to comply with field conditions and requirements for opening force.
- J. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.
- K. Weather Stripping: Manufacturer's standard replaceable components.
 - 1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
 - 2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.
- L. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.
- M. Silencers: BHMA A156.16, Grade 1.
- N. Thresholds: BHMA A156.21, raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch (12.7 mm).
- O. Finger Guards: Manufacturer's standard collapsible neoprene or PVC gasket anchored to frame hinge-jamb at center-pivoted doors.

2.05 GLAZING

- A. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- B. Glazing Sealants: As recommended by manufacturer.
- C. Provide a formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by structural-sealant manufacturer for use in storefront system indicated.
 - 1. Color: Match structural sealant.

2.06 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, nonbleeding fasteners and accessories compatible with adjacent materials.
 - 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 - 2. Reinforce members as required to receive fastener threads.
 - 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
 - 1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
- C. Concealed Flashing: Manufacturer's standard corrosion-resistant, non-staining, nonbleeding flashing compatible with adjacent materials.
- D. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

2.07 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Physical and thermal isolation of glazing from framing members.
 - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 5. Provisions for field replacement of glazing from exterior.

- 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
 - D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
 - E. Structural-Sealant-Glazed Framing Members: Include accommodations for using temporary support device to retain glazing in place while structural sealant cures.
 - F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
 - 1. At exterior doors, provide compression weather stripping at fixed stops.
 - G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
 - 1. At exterior doors, provide weather sweeps applied to door bottoms.
 - H. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
 - I. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.
- 2.08 ALUMINUM FINISHES
- A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
 - B. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Color and Gloss: Dark Bronze, as selected by Architect from manufacturer's full range.

2.09 SOURCE QUALITY CONTROL

- A. Structural Sealant: Perform quality-control procedures complying with ASTM C 1401 recommendations including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Prepare surfaces that are in contact with structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

3.03 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure non-movement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Seal perimeter and other joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Set continuous sill members and flashing in full sealant to produce weathertight installation.

D. Install components plumb and true in alignment with established lines and grades.

E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

F. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturer's written instructions using concealed fasteners to greatest extent possible.

3.04 ERECTION TOLERANCES

A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
3. Alignment:
 - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
 - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
 - c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).
4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.

3.05 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed entrances and storefronts.
 - 1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
 - a. Perform a minimum of two tests in areas as directed by Architect.
- C. Structural-Sealant Adhesion: Test structural sealant according to recommendations in ASTM C 1401, Destructive Test Method A, "Hand Pull Tab (Destructive)," Appendix X2.
 - 1. Test a minimum of two areas on each building facade.
 - 2. Repair installation areas damaged by testing.
- D. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.06 MAINTENANCE SERVICE

- A. Prepare test and inspection reports:
 - 1. 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 entrance door hardware.
 - 2. Initial Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Use parts and supplies that are the same as those used in the manufacture and installation of original equipment.

3.07 ENTRANCE DOOR HARDWARE SETS

- A. See Section 08 71 00 "Door Hardware."

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Mechanical door hardware for the following:
 - a. Swinging doors.
 - 2. Cylinders for door hardware specified in other Sections.
 - 3. Electrified door hardware.

1.02 PREINSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct pre-installation conference at Project site.
- B. Keying Conference: Conduct conference at Project site.
- C. Hardware Site Survey: Conduct a post hardware installation site survey at Project site.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For electrified door hardware.
 - 1. Include diagrams for power, signal, and control wiring.
 - 2. Include details of interface of electrified door hardware and building safety and security systems.
- C. Samples: For each exposed product in each finish specified.
- D. Door hardware schedule.
- E. Keying schedule.

1.04 INFORMATIONAL SUBMITTALS

- A. Sample warranty.

1.05 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.
 - 1. Scheduling Responsibility: Preparation of door hardware and keying schedule.
 - 2. 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 experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as an Architectural Hardware Consultant (AHC) and an Electrified Hardware Consultant (EHC).

1.07 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:
 - a. Locks: Five & Ten years from date of Substantial Completion
 - b. Exit Devices: Three years from date of Substantial Completion.
 - c. Manual Closers: Thirty years from date of Substantial Completion.
 - d. Electronic Hardware: One year from date of Substantial Completion

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire- protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
- B. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that complies with requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
 - 1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at the tested pressure differential of 0.3-inch wg (75 Pa) of water.
- C. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

- E. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the DOJ's "2010 ADA Standards for Accessible Design" and ICC/ANSI A117.1.

2.02 SCHEDULED DOOR HARDWARE

- A. Door Hardware Products: The City of Chandler uses Allegion, Southwest for all specifications for Finish Hardware products.
- B. The City of Chandler requires the following door and hardware products.
 - 1. No Substitutions or changes to the following door and hardware products allowed unless approved by the City of Chandler in writing.

2.03 HINGES

- A. Hinges: ANSI/BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.
 - 1. Manufacturer: Ives - 5BB1HW 4.5 X 4.5 NRP Heavy weight ball bearing hinges or standard weight hinges as required, in 652 finish.

2.04 CENTER-HUNG AND OFFSET PIVOTS

- A. Center-Hung and Offset Pivots: ANSI/BHMA A156.4.
 - 1. Manufacturer: Ives - Heavy-Duty Pivots 7226 with intermediate pivot 7226 INT when required.

2.05 CONTINUOUS HINGES

- A. Continuous Hinges: Are not to be used without written approval by the City of Chandler.

2.06 MECHANICAL LOCKS AND LATCHES

- A. Manufacturer: Schlage ND Series cylindrical locksets with (RHO) Rhodes lever design with the proper corresponding functions per application. All locks to be ordered either BD (less SFIC core) or GD (with Everest 29 core).
- B. Lock Functions: As indicated in door hardware schedule.
- C. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
 - 1. Bored Locks: Minimum 1/2-inch (13-mm) latchbolt throw.
 - 2. Mortise Locks: Minimum 3/4-inch (19-mm) latchbolt throw.
 - 3. Deadbolts: Minimum 1-inch (25-mm) bolt throw.
- D. Lock Backset: 2-3/4 inch (70-mm) unless otherwise indicated.
- E. Lock Trim:
 - 1. Description: As indicated on Drawings.
 - 2. Levers: Cast.

- a. Construction: Solid.
- 3. Escutcheons (Roses): Wrought.
- 4. Dummy Trim: Match lever lock trim and escutcheons.
- F. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated and with strike box and curved lip extended to protect frame; finished to match lock or latch.
- G. Bored Locks: ANSI/BHMA A156.2; Grade 1; Series 4000.
- H. Mortise Locks: ANSI/BHMA A156.13; Grade 1; stamped steel case with steel or brass parts; Series 1000.
 - 1. Manufacturers: Schlage, an Allegion brand. Manufacturers: Schlage "L" Series Mortise Lock with "N" Style Escutcheon and Rhodes style levers – All functions accordingly.
- I. Deadlocks: Schlage Series - L400 Series mortise deadbolt in 626 finish or B560 series surface applied deadbolt.
- 2.07 ELECTRIC STRIKES
 - A. Electric Strikes: ANSI/BHMA A156.31; Grade 1; As listed in hardware sets.
- 2.08 ELECTROMAGNETIC LOCKS
 - A. Electromagnetic Locks: ANSI/BHMA A156.23; electrically powered; with electromagnet attached to frame and armature plate attached to door; full-exterior or full-interior type, as required by application indicated.
- 2.09 ELECTROMECHANICAL LOCKS
 - A. Electromechanical Locks: ANSI/BHMA A156.25; Grade 1; motor or solenoid driven; with strike that suits frame.
 - 1. Electrified Lock Options: Where applicable, provide electrified options including: outside door lock/unlock trim control, latchbolt and lock/unlock status monitoring, and request-to-exit signaling. Unless otherwise indicated, provide electrified locksets standard as fail secure.
- 2.10 EXIT LOCKS AND EXIT ALARMS
 - A. Exit Locks and Alarms: ANSI/BHMA A156.29, Grade 1.
 - B. Exit Locks: Surface mounted; battery powered, housed in metal case; with manufacturer's standard strike that suits frame; with red-and-white lettering reading "EMERGENCY EXIT PUSH TO OPEN - ALARM WILL SOUND."
- 2.11 MANUAL FLUSH BOLTS
 - A. Manual Flush Bolts: ANSI/BHMA A156.16; minimum 3/4-inch (19-mm) throw; designed for mortising into door edge.

- B. Manual-Extension Flush Bolts: Grade 1, fabricated from extruded brass or aluminum, with 12-inch rod actuated by flat lever.
- C. Top-Bolt Extension Rod Length: As required to locate operating mechanism at not more than 72-inch above the finished floor at all times.

2.12 AUTOMATIC AND SELF-LATCHING FLUSH BOLTS

- A. Automatic Flush Bolts: ANSI/BHMA A156.3, Type 25; minimum 3/4-inch (19-mm) throw; with dust-proof strikes; designed for mortising into door edge.
- B. Automatic Flush Bolts: Grade 1, fabricated from steel and brass components, with spring-activated bolts that automatically retract when active leaf is opened and that automatically engage when active door depresses bolt trigger. Provide brass or stainless-steel cover plate, top and bottom strikes, guides, guide supports, wear plates, and shims.
- C. Self-Latching Flush Bolts: Grade 1, fabricated from steel and brass components, with spring-activated bolts that automatically engage when active door depresses trigger. Bolts are manually retracted by a slide in the bolt face. Provide brass or stainless-steel cover plate, top and bottom strikes, guides, guide supports, wear plates, and shims.

2.13 EXIT DEVICES AND AUXILIARY ITEMS

- A. Exit Devices and Auxiliary Items: ANSI/BHMA A156.3, Grade 1 (Heavy Duty) certified panic and fire exit hardware devices furnished in the functions required for application. Exit device latch to be stainless steel, pullman type, with deadlock feature.
- B. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
 - 1. Von Duprin 99L series rim panic exit devices in 626 finish with 996 Rhodes lever trim. 99XP device to be used on high traffic and high abuse areas. There is to be key override on every access control door. Rim by Rim Mullions are to be used where applicable.
 - 2. Von Duprin- KR 9954 key removable steel mullion for fire rated and non-rated doors.
- C. Fire Exit Devices: Devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.
 - 1. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where applicable.
 - 2. Electromechanical Options: Subject to same compliance standards and requirements as mechanical exit devices, electrified devices to be of type and design as required for application. Include any specific controllers when conventional power supplies are not sufficient to provide the proper inrush current.
 - 3. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy-duty escutcheon trim with threaded studs forthru-bolts.
 - a. Lock Trim Design: Provide finishes and designs to match that of the specified building locksets.
 - b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.

4. Vertical Rod Exit Devices: Provide and install interior surface and concealed vertical rod exit devices with top and bottom rod unless otherwise required. Provide dust proof strikes where thermal pins are required.
5. Dummy Push Bar: Nonfunctioning push bar matching functional pushbar.
6. Rail Sizing: Provide exit device rails factory sized for proper door width application.
7. Through Bolt Installation: For exit devices and trim.

2.14 LOCK CYLINDERS

- A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide cylinder from same manufacturer of locking devices.
 1. Cylinder Housings:
 - a. Schlage cylinder housings:
 - 1) Rim cylinders with Everest 29 SFIC cylinders (80-329) in 626 finish. (80-129) Less core
 - 2) Mortise cylinder housings with Everest 29 SFIC cylinders (80-302) in 626 finish. (80-102) Less core.
- B. Standard Lock Cylinders: ANSI/BHMA A156.5; Grade 1 permanent cores; face finished to match lockset.
 1. Core Type: Interchangeable or removable as required by Client.
- C. High-Security Lock Cylinders: ANSI/BHMA A156.30; Grade 1 permanent cores that are removable; face finished to match lockset.
- D. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.15 KEYING

- A. Keying System: Initiate conference with Client to develop keying system and incorporate decisions made in keying conference. Factory registered, complying with guidelines in ANSI/BHMA A156.28, appendix. Provide one extra key blank for each lock.
- B. Manufacturer: Schlage Everest 29 key system with a "R" Keyway in Small format Interchangeable Cores. All permanent cores to be keyed to the existing Schlage factory, City of Chandler Grand Master key system. The hardware supplier must supply either 1-bitted cores or factory pinned cores to follow under the existing Grand Master System and must be coordinated with the City of Chandler locksmith for approval.

2.16 KEY CONTROL SYSTEM

- A. Key Control Cabinet: ANSI/BHMA A156.28; metal cabinet with baked-enamel finish; containing key-holding hooks, labels, two 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.

2.17 OPERATING TRIM

- A. Operating Trim: ANSI/BHMA A156.6.

2.18 ACCESSORIES FOR PAIRS OF DOORS

- A. Coordinators: ANSI/BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release.
- B. Rigid, Housed Astragals: ANSI/BHMA A156.22; gasket material held in place by metal housing; fastened to face of door with screws.
- C. Overlapping-with-Gasket Astragals: ANSI/BHMA A156.22; T-shaped metal, surface mounted on edge of door with screws.

2.19 SURFACE CLOSERS

- A. Surface Closers: ANSI/BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions 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.
- B. Surface Closer with Cover: Grade 1; Modern type with mechanism enclosed in cover.
- C. Manufacturers: LCN- 4040XP Series extra heavy duty surface mounted door closers in aluminum finish (689). Provide proper arm function as required.

2.20 MECHANICAL STOPS AND HOLDERS

- A. Wall- and Floor-Mounted Stops: ANSI/BHMA A156.16.
 - 1. Manufacturers:
 - a. Wall Stops: Ives- WS401 series, convex or concave wall stops in 626 finish, as required.
 - b. Floor Stops: Ives- FS444 series heavy duty floor mounted Stops at all exterior doors.

2.21 ELECTROMAGNETIC STOPS AND HOLDERS

- A. Electromagnetic Door Holders: ANSI/BHMA A156.15, Grade 1; wall-mounted electromagnetic single unit with strike plate attached to swinging door; coordinated with fire detectors and interface with fire-alarm system for labeled fire-rated door assemblies.
 - 1. Manufacturers: LCN 7850 Die cast housing, standard profile recessed wall mount. Tri-voltage design with 35 lb. holding force.

2.22 OVERHEAD STOPS AND HOLDERS

- A. Overhead Stops and Holders: ANSI/BHMA A156.8.

1. Manufacturers: Glynn-Johnson 900 or 450 Series, surface mounted overhead stops or holders in 626 finish when required.

2.23 DOOR GASKETING

- A. Door Gasketing: ANSI/BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.
 1. Manufacturers: Pemko, Zero products, as required.
- B. Maximum Air Leakage: When tested according to ASTM E283 with tested pressure differential of 0.3-inch wg (75 Pa), as follows:
 1. Smoke-Rated Gasketing: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
 2. Gasketing on Single Doors: 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) of door opening.
 3. Gasketing on Double Doors: 0.50 cfm per foot (0.000774 cu. m/s per m) of door opening.

2.24 METAL PROTECTIVE TRIM UNITS

- A. Metal Protective Trim Units: ANSI/BHMA A156.6; fabricated from 0.050-inch (1.3-mm) thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.
 1. Manufacturers: Ives- 8400 Series, 10-inch high, heavy duty stainless steel kick plates with beveled three edges as required.

2.25 AUXILIARY DOOR HARDWARE

- A. Auxiliary Hardware: ANSI/BHMA A156.16.
- B. Silencers for Metal Door Frames: Grade 1; neoprene or rubber; minimum diameter 1/2-inch; fabricated for drilled-in application to frame.

2.26 AUXILIARY ELECTRIFIED DOOR HARDWARE

- A. Boxed Power Supplies: Modular unit in NEMA ICS 6, Type 4 enclosure; filtered and regulated; voltage rating and type matching requirements of door hardware served; listed and labeled for use with fire-alarm systems.
- B. Door Position Switches: Magnetically operated reed switch designed for concealed mounting.
- C. Door and Frame Transfer Devices: Steel housing for mortise in hinge stile of door, with flexible tube for wiring bundle; accommodating doors that swing open to 120degrees
- D. Manufacturers: Lenel access control software with Schlage electronic locking hardware, HES Strikes, Schlage multi-tech readers, Schlage credentials and Schlage offline and wireless networked products.

2.27 FINISHES

- A. Provide finishes complying with ANSI/BHMA A156.18 as indicated in hardware sets.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Custom Steel Doors and Frames: HMMA 831.
 - 3. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. 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. Do not install surface-mounted items until finishes have been completed on substrates involved.
- C. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- D. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- E. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- F. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30-inch (750-mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- G. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 - 1. Replace construction cores with permanent cores as directed by Owner.
 - 2. Furnish permanent cores to Owner for installation.
- H. Wiring: Coordinate with Division 26, ELECTRICAL sections for:
 - 1. Conduit, junction boxes and wire pulls.
 - 2. Connections to and from power supplies to electrified hardware.
 - 3. Connections to fire/smoke alarm system and smoke evacuation system.
 - 4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
 - 5. Testing and labeling wires with Architect's opening number.
- I. Key Control Cabinet: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- J. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, in equipment room. Verify location with Architect.

1. Configuration: Provide one power supply for each door opening with electrified door hardware.
 - K. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 07 92 00 "Joint Sealants."
 - L. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
 - M. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
 1. Do not notch perimeter gasketing to install other surface-applied hardware.
 - N. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
 - O. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.
- 3.02 FIELD QUALITY CONTROL
- A. Architectural Hardware Consultant: Engage qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
 1. Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.
- 3.03 ADJUSTING
- A. Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
- 3.04 DOOR HARDWARE INFO
- A. OPT0282664, 07.05.2022, V1.
- 3.05 HARDWARE SETS
- A. While the following hardware sets are intended to cover all doors, and establish a type and standard of quality, it is the responsibility of the hardware supplier to examine the plans and specifications and furnish proper hardware for all openings. The hardware supplier shall review the entire specification versus the door schedule and notify the architect of any errors, inconsistencies, or omissions during the bid period.
 - B. Elevation riser diagrams included in this section and/or section 28 1300 are based on the electrified products listed in the hardware sets. Any deviation from specified hardware products shall make the elevation riser diagrams null and void. If non-specified products are submitted on, material supplier to provide new elevation riser diagrams as part of their submittal package.

Abbreviation	Name
GLY	Glynn-Johnson Corp
HES	Hes Inc
IVE	H.B. Ives
LCN	LCN Commercial Division
SCE	Schlage Electronic Security
SCH	Schlage Lock Company
VON	Von Duprin
ZER	Zero International Inc

⚡ = Hardware Item Requiring Electrical Coordination

HARDWARE SET: 01

DOOR NUMBER:

1001AX 1002AX

EACH TO HAVE:

NO WORK

EXISTING DOORS, FRAME AND HARDWARE TO REMAIN

HARDWARE SET: 02

DOOR NUMBER:

1001BX 1015AX 1016AX 1017AX

EACH TO HAVE:

NO WORK

EXISTING DOOR, FRAME AND HARDWARE TO REMAIN

HARDWARE SET: 03

DOOR NUMBER:

1003A

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	ND70BD RHO	626	SCH
1	EA	PERM CORE	80-037	626	SCH
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS401/402CVX	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE SET: 04

DOOR NUMBER:

1004A 1023A

EACH TO HAVE:

3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	ND80BD RHO	626	SCH
1	EA	PERM CORE	80-037	626	SCH
1	EA	ELECTRIC STRIKE	4500C AS REQUIRED	630	HES
1	EA	LOCK GUARD	150	630	IVE
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP EDA	689	LCN
1	EA	RAIN DRIP	142AA	AA	ZER
1	EA	SWEEP	477AA	AA	ZER
1	EA	THRESHOLD	8655A 223	A	ZER
1	EA	CARD READER	MT15 12 VDC	BLK	SCE
1	EA	DOOR CONTACT	679-05	BLK	SCE
1	EA	REQUEST TO EXIT	SCAN II	BLK	SCE
1		SEAL	BY FRAME MANUF		

-DOOR NORMALLY CLOSED AND LOCKED

-PRESENT VALID CREDENTIAL TO READER OR KEY OVERRIDE FOR ENTRY.

-FREE EGRESS AT ALL TIMES

-REQUEST TO EXIT SHUNTS DOOR FORCED OPEN ALARM IN ACCESS CONTROL SYSTEM UPON EGRESS.

-FAIL SECURE

HARDWARE SET: 05

DOOR NUMBER:

1004B

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	CLASSROOM LOCK	ND70BD RHO	626	SCH
1	EA	PERM CORE	80-037	626	SCH
1	EA	SURFACE CLOSER	4040XP EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS401/402CVX	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE SET: 06

DOOR NUMBER:

1006A

EACH TO HAVE:

3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	PANIC DEVICE	99-L-06		626	VON
1	EA	RIM CYLINDER	80-129		626	SCH
1	EA	PERM CORE	80-037		626	SCH
1	EA	OH STOP	100S		630	GLY
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	RAIN DRIP	142AA		AA	ZER
1	SET	WEATHERSTRIP	8303A		AA	ZER
1	EA	SWEEP	39A		A	ZER
1	EA	THRESHOLD	8655A 223		A	ZER

HARDWARE SET: 07

DOOR NUMBER:

1006B

EACH TO HAVE:

3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	ELECTRIC STRIKE	9600 AS REQUIRED		630	HES
1	EA	PANIC DEVICE	99-L-06		626	VON
1	EA	RIM CYLINDER	80-129		626	SCH
1	EA	PERM CORE	80-037		626	SCH
1	EA	OH STOP	100S		630	GLY
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	SWEEP	477AA		AA	ZER
1	EA	THRESHOLD	8655A 223		A	ZER
1	EA	CARD READER	MT15 12 VDC		✂ BLK	SCE
1	EA	DOOR CONTACT	679-05		✂ BLK	SCE
1	EA	REQUEST TO EXIT	SCAN II		✂ BLK	SCE
1		SEAL	BY FRAME MANUF			

-DOOR NORMALLY CLOSED AND LOCKED

-PRESENT VALID CREDENTIAL TO READER OR KEY OVERRIDE FOR ENTRY.

-FREE EGRESS AT ALL TIMES

-REQUEST TO EXIT SHUNTS DOOR FORCED OPEN ALARM IN ACCESS CONTROL SYSTEM UPON EGRESS.

-FAIL SECURE

HARDWARE SET: 08

DOOR NUMBER:

1007AX

EACH TO HAVE:

1	EA	ENTRANCE LOCK	ND53BD RHO		626	SCH
1	EA	PERM CORE	80-037		626	SCH
1	EA	OH STOP	90S		630	GLY
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	DOOR SEAL	188S		BK	ZER

REUSE REMAINDER OF EXISTING HARDWARE.

HARDWARE SET: 09

DOOR NUMBER:

1008AX

EACH TO HAVE:

EXISTING DOOR, FRAME, AND HARDWARE TO REMIAN

HARDWARE SET: 10

DOOR NUMBER:

1008BX

EACH TO HAVE:

1	EA	CLASSROOM LOCK	ND70BD RHO		626	SCH
1	EA	PERM CORE	80-037		626	SCH

REUSE REMAINDER OF EXISTING HARDWARE.

HARDWARE SET: 11

DOOR NUMBER:

1012A

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	ND80BD RHO		626	SCH
1	EA	PERM CORE	80-037		626	SCH
1	EA	ELECTRIC STRIKE	4500C AS REQUIRED		✓ 630	HES
1	EA	SURFACE CLOSER	4040XP REG		695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS401/402CVX		626	IVE
1	SET	WEATHERSTRIP	8303A		AA	ZER
1	EA	DOOR BOTTOM	111AA		AA	ZER
1	EA	THRESHOLD	546A-223		A	ZER
1	EA	CARD READER	MT15 12 VDC		✓ BLK	SCE
1	EA	DOOR CONTACT	679-05		✓ BLK	SCE
1	EA	REQUEST TO EXIT.	SCAN II		✓ BLK	SCE

-DOOR NORMALLY CLOSED AND LOCKED

-PRESENT VALID CREDENTIAL TO READER OR KEY OVERRIDE FOR ENTRY.

-FREE EGRESS AT ALL TIMES

-REQUEST TO EXIT SHUNTS DOOR FORCED OPEN ALARM IN ACCESS CONTROL SYSTEM UPON EGRESS.

-FAIL SECURE

HARDWARE SET: 12

DOOR NUMBER:

1010A

1011A

1013A

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PRIV W/INDICATOR	L9044 06A L583-363 L283-722		626	SCH
1	EA	SURFACE CLOSER	4040XP REG		695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS401/402CVX		626	IVE
1	EA	DOOR SEAL	188S		BK	ZER

HARDWARE SET: 13

DOOR NUMBER:

1018A

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	STOREROOM LOCK	ND80BD RHO		626	SCH
1	EA	PERM CORE	80-037		626	SCH
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS401/402CVX		626	IVE
3	EA	SILENCER	SR64		GRY	IVE

HARDWARE SET: 14

DOOR NUMBER:

1019A

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	STOREROOM LOCK	ND80BD RHO		626	SCH
1	EA	PERM CORE	80-037		626	SCH
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS401/402CVX		626	IVE
3	EA	SILENCER	SR64		GRY	IVE

HARDWARE SET: 15

DOOR NUMBER:

1022A

1024A

1028A

1029A

1030A

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	ENTRANCE LOCK	ND53BD RHO		626	SCH
1	EA	PERM CORE	80-037		626	SCH
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS401/402CCV		626	IVE
1	EA	DOOR SEAL	188S		BK	ZER

HARDWARE SET: 16

DOOR NUMBER:

1014BX

1029H

EACH TO HAVE:

ROLL-UP OVERHEAD DOOR

HARDWARE SET: 17

DOOR NUMBER:

1008CX

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	STOREROOM LOCK	ND80BD RHO		626	SCH
1	EA	PERM CORE	80-037		626	SCH
1	EA	ELECTRIC STRIKE	4500C AS REQUIRED	 ✕	630	HES
1	EA	SURFACE CLOSER	4040XP EDA		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS401/402CVX		626	IVE
1	SET	WEATHERSTRIP	8303A		AA	ZER
1	EA	DOOR BOTTOM	111AA		AA	ZER
1	EA	THRESHOLD	546A-223		A	ZER
1	EA	CARD READER	MT15 12 VDC	 ✕	BLK	SCE
1	EA	DOOR CONTACT	679-05	 ✕	BLK	SCE
1	EA	REQUEST TO EXIT	SCAN II	 ✕	BLK	SCE

-DOOR NORMALLY CLOSED AND LOCKED

-PRESENT VALID CREDENTIAL TO READER OR KEY OVERRIDE FOR ENTRY.

-FREE EGRESS AT ALL TIMES

-REQUEST TO EXIT SHUNTS DOOR FORCED OPEN ALARM IN ACCESS CONTROL SYSTEM UPON EGRESS.

-FAIL SECURE

HARDWARE SET: 18

DOOR NUMBER:

1012B

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	STOREROOM LOCK	ND80BD RHO		626	SCH
1	EA	PERM CORE	80-037		626	SCH
1	EA	ELECTRIC STRIKE	4500C AS REQUIRED	 ✕	630	HES
1	EA	SURFACE CLOSER	4040XP REG		695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS401/402CVX		626	IVE
1	EA	DOOR SEAL	188S		BK	ZER
1	EA	CARD READER	MT15 12 VDC	 ✕	BLK	SCE
1	EA	DOOR CONTACT	679-05	 ✕	BLK	SCE
1	EA	REQUEST TO EXIT	SCAN II	 ✕	BLK	SCE

-DOOR NORMALLY CLOSED AND LOCKED

-PRESENT VALID CREDENTIAL TO READER OR KEY OVERRIDE FOR ENTRY.

-FREE EGRESS AT ALL TIMES

-REQUEST TO EXIT SHUNTS DOOR FORCED OPEN ALARM IN ACCESS CONTROL SYSTEM UPON EGRESS.

-FAIL SECURE

END OF SECTION

SECTION 08 80 00

GLAZING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Glass for windows, doors, interior borrowed lites, and storefront framing.
2. Glazing sealants and accessories.

1.02 COORDINATION

- A.** Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.03 ACTION SUBMITTALS

- A.** Product Data: For each type of product.
- B.** Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.
- C.** Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- D.** Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E.** Refer to Section 08 87 53 – Security Glazing.

1.04 INFORMATIONAL SUBMITTALS

- A.** Preconstruction adhesion and compatibility test report.

1.05 QUALITY ASSURANCE

- A.** Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

1.06 PRECONSTRUCTION TESTING

- A.** Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

1.07 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AGC Glass Company North America, Inc.
 2. Cardinal Glass Industries.
 3. Dlubak Corporation.
 4. Guardian Industries Corp.
 5. Oldcastle BuildingEnvelope.
 6. Pilkington North America Inc.
 7. PPG Industries, Inc.
 8. Saint-Gobain Corporation.
 9. Trulite Glass & Aluminum Solutions.
 10. Viracon, Inc.
- B. Basis of Design Product: Guardian Industries SunGuard Solar glazing.

2.02 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the International Building Code and ASTM E 1300.
1. Design Wind Pressures: As indicated on Drawings.
 2. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.
 3. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- B. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

- C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
1. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
 2. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
 3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.03 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
 2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
 3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
 4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
- E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.04 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.
- B. Tinted Annealed Float Glass: ASTM C 1036, Type I, Class 2 (tinted), Quality-Q3.
- C. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
- D. Heat-Strengthened Float Glass: ASTM C 1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

2.05 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
1. Sealing System: Dual seals.
 2. Spacer: Manufacturer's standard spacer material and construction.

2.06 GLAZING SEALANTS

- A. General:
1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 3. Field-applied sealants shall have a VOC content of not more than 250 g/L.
 4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Corning Corporation; 790.
 - b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
 - c. May National Associates, Inc.; Bondaflex Sil 290.
 - d. Pecora Corporation; 890NST.
 - e. Sika Corporation U.S.; Sikasil WS-290.
 - f. Tremco Incorporated; Spectrem 1.

2.07 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 tape, where indicated.
 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.08 MISCELLANEOUS GLAZING MATERIALS

- A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- E. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

PART 3 - EXECUTION

3.01 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.02 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Apply heel bead of elastomeric sealant.
- F. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- G. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.03 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.04 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.

3.05 MONOLITHIC GLASS SCHEDULE

A. Glass Type G-01: Clear fully tempered float glass.

1. Minimum Thickness: 1/4 inch (6 mm).
2. Safety glazing required.

3.06 INSULATING GLASS SCHEDULE

A. Glass Type G-02: Tinted insulating glass.

1. Basis-of-Design Product: Guardian SunGuard Solar .
2. Overall Unit Thickness: 1 inch (25 mm).
3. Minimum Thickness of Each Glass Lite: 1/4 inch (6 mm).
4. Outdoor Lite: Tinted annealed float glass.
5. Tint Color: Gray. No tint required where tinted film is applied (see drawings).
6. Interspace Content: Air.
7. Indoor Lite: Clear annealed float glass.
8. Winter Nighttime U-Factor: 0.45 maximum.
9. Summer Daytime U-Factor: 0.45 maximum.
10. Visible Light Transmittance: 80 percent minimum.
11. Solar Heat Gain Coefficient: 0.25 maximum.
12. Safety glazing required.

END OF SECTION

SECTION 08 87 16

SAFETY AND SECURITY WINDOW FILM

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes safety and security window film.
- B. Related Sections: Section 08 80 00 - Glazing; for glass; and shatter resistant, IR-rejecting, solar control, clear window films designed to be applied to interior window surfaces to hold broken glass together.

1.02 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on security glazing, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.03 PERFORMANCE REQUIREMENTS

- A. Flammability: Surface burning characteristics when tested in accordance ASTM E 84, demonstrating film applied to glass rated Class A for Interior Use:
 - 1. Flame Spread Index: No greater than 25.
 - 2. Smoke Developed Index: No greater than 55.
- B. Performance Submittals: Provide laboratory data of emissivity and calculated window U-Factors for various outdoor temperatures based upon established calculation procedure defined by the ASHRAE Handbook of Fundamentals, Chapter 29, or Lawrence Berkeley Laboratory Window 5.2 Computer Program.

1.04 ACTION SUBMITTALS

- A. Product Data: Manufacturer's current technical literature on each product to be used, including:
 - 1. Manufacturer's Data Sheets.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Installation methods.
- B. Security Glazing Film Samples: For each type of security glazing film; 12 inches (300 mm) square.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of ten years' experience.
- B. Provide documentation that the adhesive used on the specified film is a Pressure Sensitive Adhesive (PSA).

- C. Installer Qualifications: All products listed in this section are to be installed by a single installer with a minimum of five years demonstrated experience in installing products of the same type and scope as specified.
 - 1. Provide documentation that the installer is authorized by the Manufacturer to perform Work specified in this section.
 - 2. Provide a commercial building reference list of 5 properties where the installer has applied window film. This list will include the following information:
 - a. Name of building.
 - b. The name and telephone number of a management contact.
 - c. Type of glass.
 - d. Type of film and/or film attachment system.
 - e. Amount of film and/or film attachment system installed.
 - f. Date of completion.
- D. Provide a Glass Stress Analysis of the existing glass and proposed glass/film combination as recommended by the film manufacturer.
- E. Provide an EFilm application analysis to determine available energy cost reduction and savings.
- F. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - 1. Finish areas designated by Architect.
 - 2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
 - 3. Refinish mock-up area as required to produce acceptable work.

1.06 PROJECT CONDITIONS

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

1.07 WARRANTY

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

PART 2 - PRODUCTS

2.01 SECURITY FILM

- A. Basis-of-Design Product: Avery Dennison Reflective Safety Film "R Silver 20 - 9 mil.
- B. Safety Glazing: Retrofit new glazing assemblies to provide impact resistance complying with ANSI Z97.1 and 16 CFR 1201, Category II.
- C. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84 (Class A).
- D. Optical and Solar Properties of Film Applied on 1/8 inch (3 mm) Thick Clear Annealed Glass:
 - 1. Visible Light Transmittance: 20 percent.

2. % Total Solar Energy:
 - a. 15 percent transmitted.
 - b. 50 percent reflected.
 - c. 35 percent absorbed.
 3. Shading Coefficient: 0.30
 4. U Factor (winter-IP): 1.08
- E. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84 (Class A).
- F. Mechanical Properties of Film Applied on 1/8 inch (3 mm) Thick Clear Annealed Glass:
1. Thickness: .009 inch (9 mil).
 2. Tensile strength at break: 28,500 psi
 3. Break strength: 245 pounds/inch
 4. Elongation at break: 125%
 5. Peel strength: 7 pounds/inch
- 2.02 Accessory Materials: As recommended or required by film manufacturer.
- 2.03 Glass Cleaner: As recommended by glazing film manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Film Examination:
1. If preparation of glass surfaces is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.
 2. Glass surfaces receiving new film should first be examined to verify that they are free from defects and imperfections, which will affect the final appearance.
 3. Do not proceed with installation until glass surfaces have been properly prepared and deviations from manufacturer's recommended tolerances are corrected. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result under the project conditions.
 4. Commencement of installation constitutes acceptance of conditions.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

Refer to Manufacturer's installation instructions for methods of preparation for Impact Protection Attachment Sealant film attachment systems.

3.03 INSTALLATION

- A. Film Installation:
1. Install in accordance with manufacturer's instructions.
 2. Cut film edges neatly and square at a uniform distance of 1/8 inch (3 mm) to 1/16 inch (1.5 mm) of window sealant. Use new blade tips after 3 to 4 cuts.

3. Spray the slip solution, composed of one capful of baby shampoo or dishwashing liquid to 1 gallon of water, on window glass and adhesive to facilitate proper positioning of film.
4. Apply film to glass and lightly spray film with slip solution.
5. Squeegee from top to bottom of window. Spray slip solution to film and squeegee a second time.
6. Bump film edge with lint-free towel wrapped around edge of a 5-way tool.
7. Upon completion of film application, allow 30 days for moisture from film installation to dry thoroughly, and to allow film to dry flat with no moisture dimples when viewed under normal viewing conditions.

3.04 CLEANING AND PROTECTION

- A. Remove left over material and debris from Work area. Use necessary means to protect film before, during, and after installation.
- B. Touch-up, repair or replace damaged products before Substantial Completion.
- C. After application of film, wash film using common window cleaning solutions, including ammonia solutions, 30 days after application. Do not use abrasive type cleaning agents and bristle brushes to avoid scratching film. Use synthetic sponges or soft cloths.

END OF SECTION

SECTION 09 22 16

NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Non-load-bearing steel framing systems for interior partitions.
 - 2. Suspension systems for interior ceilings and soffits.

1.02 ACTION SUBMITTALS

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

1.03 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of code-compliance certification for studs and tracks.
- B. Evaluation reports for firestop tracks, post-installed anchors and power-actuated fasteners.

1.04 QUALITY ASSURANCE

- A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Steel Framing Industry Association or the Steel Stud Manufacturers Association.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.02 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C754 for conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM C645 requirements for steel unless otherwise indicated.
 - 2. Protective Coating: ASTM A653/A653M, G60 (Z180), hot-dip galvanized unless otherwise indicated.
- B. Studs and Tracks: ASTM C645.

1. Minimum Base-Steel Thickness: As indicated on Drawings.
 2. Depth: As indicated on Drawings.
- C. Slip-Type Head Joints: Where indicated, provide one of the following:
1. Single Long-Leg Track System: ASTM C645 top track with 2-inch (51-mm) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging located within 12-inch (305-mm) of the top of studs to provide lateral bracing.
 2. Double-Track System: ASTM C645 top outer tracks, inside track with 2-inch (51-mm) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction-fit over inner track.
 3. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- D. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Minimum Base-Steel Thickness: As indicated on Drawings.
- F. Cold-Rolled Channel Bridging: Steel, 0.0538-inch (1.367-mm) minimum base-steel thickness, with minimum 1/2-inch (13-mm) wide flanges.
1. Depth: As indicated on Drawings.
 2. Clip Angle: Not less than 1-1/2- by 1-1/2-inch (38- by 38-mm), 0.068-inch (1.72-mm) thick, galvanized steel.
- G. Hat-Shaped, Rigid Furring Channels: ASTM C645.
1. Minimum Base-Steel Thickness: As indicated on Drawings.
 2. Depth: As indicated on Drawings.
- H. Resilient Furring Channels: 1/2-inch (13-mm) deep, steel sheet members designed to reduce sound transmission.
1. Configuration: Asymmetrical or hat shaped.
- I. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch (13-mm) wide flanges.
1. Depth: As indicated on Drawings.
 2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329-inch (0.8-mm).
 3. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch (1.59-mm) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
- J. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4-inch (32-mm), wall attachment flange of 7/8-inch (22-mm), minimum uncoated-steel thickness of 0.0179-inch (0.455-mm), and depth required to fit insulation thickness indicated.

2.03 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch (1.59-mm) diameter wire, or double strand of 0.048-inch (1.21-mm) diameter wire.
- B. Hanger Attachments to Concrete:
 - 1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or AC308 as appropriate for the substrate.
 - a. Uses: Securing hangers to structure.
 - b. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941 (ASTM F1941M), Class Fe/Zn 5, unless otherwise indicated.
- C. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16-inch (4.12-mm) in diameter.
- D. Flat Hangers: Steel sheet, in size indicated on Drawings.
- E. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538-inch (1.367-mm) and minimum 1/2-inch (13-mm) wide flanges.
 - 1. Depth: As indicated on Drawings.
- F. Furring Channels (Furring Members):
 - 1. Cold-Rolled Channels: 0.0538-inch (1.367-mm) uncoated-steel thickness, with minimum 1/2-inch (13-mm) wide flanges, 3/4-inch (19-mm) deep.
 - 2. Steel Studs and Tracks: ASTM C645.
 - a. Minimum Base-Steel Thickness: As indicated on Drawings.
 - b. Depth: As indicated on Drawings.
 - 3. Hat-Shaped, Rigid Furring Channels: ASTM C645, 7/8-inch (22-mm) deep.
 - a. Minimum Base-Steel Thickness: As indicated on Drawings.
 - 4. Resilient Furring Channels: 1/2-inch (13-mm) deep members designed to reduce sound transmission.
 - a. Configuration: Asymmetrical or hat shaped.

2.04 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide one of the following:

1. Asphalt-Saturated Organic Felt: ASTM D226/D226M, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8-inch (3.2-mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C754.
 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.02 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
6. Curved Partitions:
 - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
 - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6-inch (150-mm) o.c.

E. Direct Furring:

1. Screw to wood framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24-inch (610-mm) o.c.

F. Z-Shaped Furring Members:

1. Erect insulation, specified in Section 07 21 00 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24-inch (610-mm) o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24-inch (610-mm) o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12-inch (305-mm) from corner and cut insulation to fit.

- G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8-inch (3-mm) from the plane formed by faces of adjacent framing.

3.03 INSTALLING CEILING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

- a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 - 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 5. Do not attach hangers to steel roof deck.
 - 6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 - 7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 - 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- F. Installation Tolerances: Install suspension systems that are level to within 1/8-inch in 12-feet (3-mm in 3.6-m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION

SECTION 09 29 00

GYPSUM BOARD

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Interior gypsum board.
 - 2. Specialty gypsum board.
 - 3. Tile backing panels.
 - 4. Texture finishes.
 - 5. Bullet resistant fiberglass panels for walls indicated on drawings.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each texture finish indicated on same backing indicated for Work.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.02 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.03 INTERIOR GYPSUM BOARD

- A. Manufacturers: Subject to compliance with requirements, provide one of the following:
 - 1. American Gypsum.
 - 2. CertainTeed Corp.
 - 3. Georgia-Pacific Gypsum LLC.
 - 4. National Gypsum Company.
 - 5. USG Corporation.
 - 6. Or pre-approved equal.

- B. Gypsum Board, Type X: ASTM C1396/C1396M.

1. Thickness: 5/8-inch (15.9-mm).
2. Long Edges: Tapered.

C. Gypsum Ceiling Board: ASTM C1396/C1396M.

1. Thickness: 5/8-inch (15.9-mm).
2. Long Edges: Tapered.

D. Abuse-Resistant Gypsum Board: ASTM C1396/C1396M gypsum board, tested according to ASTM C1629/C1629M.

1. Core: 5/8-inch (15.9-mm), Type X.
2. Surface Abrasion: ASTM C1629/C129M, meets or exceeds Level 2 requirements.
3. Indentation: ASTM C1629/C1629M, meets or exceeds Level 2 requirements.
4. Soft-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 2 requirements.
5. Long Edges: Tapered.
6. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

E. Impact-Resistant Gypsum Board: ASTM C1396/C1396M gypsum board, tested according to ASTM C1629/C1629M.

1. Core: 5/8-inch (15.9-mm), Type X.
2. Surface Abrasion: ASTM C1629/C1629M, meets or exceeds Level 2 requirements.
3. Indentation: ASTM C1629/C1629M, meets or exceeds Level 2 requirements.
4. Soft-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 2 requirements.
5. Hard-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 2 requirements according to test in Annex A1.
6. Long Edges: Tapered.
7. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.04 SPECIALTY GYPSUM BOARD

A. Gypsum Board, Type C: ASTM C1396/C1396M. Manufactured to have increased fire-resistive capability.

1. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
2. Long Edges: Tapered.

B. Acoustically Enhanced Gypsum Board: ASTM C1396/C1396M. Multilayer products constructed of two layers of gypsum boards sandwiching a viscoelastic sound-absorbing polymer core.

1. Manufacturers: Subject to compliance with requirements, provide one of the following:
 - a. Acoustical Surfaces, Inc.
 - b. CertainTeed Corp.
 - c. National Gypsum Company.
 - d. Or pre-approved equal.
2. Core: 5/8-inch (15.9-mm), Type X.
3. Long Edges: Tapered.

2.05 TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Board: ASTM C1178/C1178M, with manufacturer's standard edges.
 - 1. Core: 5/8-inch (15.9-mm), Type X.
 - 2. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.
- B. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges.
 - 1. Thickness: As indicated.
 - 2. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.06 TRIM ACCESSORIES

- A. Interior Trim: ASTM C1047.
 - 1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.

2.07 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
 - 2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
 - 3. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
 - 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
 - 5. Skim Coat: For final coat of Level 5 finish, use high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.
- D. Joint Compound for Tile Backing Panels:
 - 1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
 - 2. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.08 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Security Mesh: ASTM A1011 and ASTM F1267. Steel expanded metal mesh panels manufactured specifically for security purposes. ASM 1.0-16F, 18 ga (0.0475-inch).
- C. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- D. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
 - 1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033- to 0.112-inch (0.84- to 2.84-mm) thick.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- E. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- F. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E90.
- G. Thermal Insulation: As specified in Section 07 21 00 "Thermal Insulation."

2.09 TEXTURE FINISHES

- A. Primer: As recommended by textured finish manufacturer.
- B. Polystyrene Aggregate Ceiling Finish: Water-based, job-mixed, polystyrene aggregate finish with flame-spread and smoke-developed indexes of not more than 25 when tested according to ASTM E84.
 - 1. Texture: Fine.
- C. Aggregate Finish: Water-based, job-mixed, aggregated, drying-type texture finish for spray application.
 - 1. Texture: Light spatter.
- D. Non-Aggregate Finish: Premixed, vinyl texture finish for spray application.
 - 1. Texture: Orange peel.
- E. Acoustical Finish: Water-based, chemical-setting or drying-type, job-mixed texture finish for spray application.

1. Application Thickness: 1/2-inch (12.7-mm).
2. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
3. NRC: 0.55 according to ASTM C423.

PART 3 - EXECUTION

3.01 APPLYING AND FINISHING PANELS

- A. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- B. Comply with ASTM C840.
- C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch (6.4- to 12.7-mm) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- D. For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
 1. Control Joints: Install control joints according to ASTM C 840, except install expansion joints at 24-feet (7315-mm) o.c. maximum, and in specific locations approved by Architect for visual effect.
- E. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- F. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- G. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 2. Level 2: Where indicated on Drawings.
 3. Level 3: Where indicated on Drawings.
 4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."
 5. Level 5: Where indicated on Drawings.
 - a. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."
- H. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

- I. Cementitious Backer Units: Finish according to manufacturer's written instructions.
- J. Apply bullet resistant fiberglass panels tightly to non-load-bearing partitions behind gypsum board per manufacturer's instructions, using screws or an industrial adhesive. Reinforce joints with a back-up layer of bullet resistive material. Minimum width of reinforcing layer at joint shall be 4-inch, centered on panel joints.

3.02 APPLYING TEXTURE FINISHES

- A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.
- B. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture matching approved mockup and free of starved spots or other evidence of thin application or of application patterns.

3.03 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION

SECTION 09 30 13

CERAMIC TILING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Porcelain tile.
 - 2. Glazed Wall Tile.
 - 3. Tile backing panels.
 - 4. Waterproof membrane for thinset applications.
 - 5. Metal edge strips.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples:
 - 1. Each type and composition of tile and for each color and finish required.
 - 2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required.

1.03 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.04 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer is a Five-Star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.
 - 2. Installer's supervisor for Project holds the International Masonry Institute's Foreman Certification.
 - 3. Installer employs only Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers for Project.

4. Installer employs at least one installer for Project that has completed the Advanced Certification for Tile Installers (ACT) certification for installation of gauged porcelain tile/gauged porcelain tile panels and slabs and large format tile.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Build mockup of each type of floor tile installation.
 2. Build mockup of each type of wall tile installation.
 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.01 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide Standard-grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

2.02 MANUFACTURERS

- A. Furnish products of one of the following Manufacturers, or Approved Equal:

1. Ceramic Tiles
 - a. American Olean Tile Company.
 - b. Arizona Tile.
 - c. Crossville.
 - d. Dal-Tile Corporation.
 - e. Emser International, Los Angeles, CA.
 - f. Interceramic USA, Carrollton, TX.
 - g. Or pre-approved equal.
2. Porcelain Ceramic Tiles
 - a. American Olean Tile Company.
 - b. Arizona Tile.
 - c. Dal-Tile Corporation.
 - d. Emser International.
 - e. Floor Gres Ceramiche.
 - f. Marrazi.
 - g. Or pre-approved equal.

- B. Basis-of-Design Manufacturer: Dal-Tile.

2.03 TILE PRODUCTS

- A. Ceramic Tile Type (**CT-1**): Glazed wall porcelain tile.

1. Basis-of-Design: Marrazi "Alterations AT61 "Cotton""
2. Certification: Tile certified by the Porcelain Tile Certification Agency.
3. Face Size: 12- by 24-inch (304.8- by 863.6-mm).
4. Face Size Variation: Rectified.
5. Thickness: 5/16-inch (8-mm).
6. Face: As indicated.
7. Dynamic Coefficient of Friction: Not less than 0.42.
8. Tile Color, Glaze, and Pattern: As selected by Architect from manufacturer's full range.
9. Grout Color (**GR-1**): As selected by Architect from manufacturer's full range.

B. Ceramic Tile Type (**CT-2**): Glazed floor tile.

1. Basis-of-Design: American Olean "Unglazed Mosaics."
2. Module Size: 2-inch by 2-inch (50.8- by 50.8-mm).
3. Face Size Variation: Rectified.
4. Thickness: 5/16-inch (8-mm).
5. Face: As indicated.
6. Tile Color and Pattern: As selected by Architect from manufacturer's full range.
7. Grout Color (**GR-1**): As selected by Architect from manufacturer's full range.

2.04 TILE BACKING PANELS

- A. Refer to Section 09 29 00 - Gypsum Board, for tile backing panels.

2.05 WATERPROOF MEMBRANE

- A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
1. PRP 315 two-component synthetic polymer anti-fracture and waterproofing membrane and as manufactured by Mapei Corporation, meeting ANSI A118.10, trowel-applied.
 2. Schluter KERDI sheet waterproofing membrane.
 3. Other sheet waterproofing membrane meeting International Plumbing Code and so labeled and acceptable to Architect as an approved equal.

2.06 SETTING MATERIALS

- A. Standard Dry-Set Mortar (Thinset): ANSI A118.1.
1. For wall applications, provide nonsagging mortar.
- B. Modified Dry-Set Mortar (Thinset): ANSI A118.4.
1. Provide prepackaged, dry-mortar mix to which only water must be added at Project site.
 2. Provide prepackaged, dry-mortar mix combined with liquid-latex additive at Project site.
 3. For wall applications, provide nonsagging mortar.
- C. Improved Modified Dry-Set Mortar (Thinset): ANSI A118.15.
1. Provide prepackaged, dry-mortar mix to which only water must be added at Project site.
 2. Provide prepackaged, dry-mortar mix combined with liquid-latex additive at Project site.
 3. For wall applications, provide nonsagging mortar.

D. Water-Cleanable, Tile-Setting Epoxy: ANSI A118.3.

E. Organic Adhesive: ANSI A136.1, Type I.

2.07 GROUT MATERIALS

A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.

B. Standard Cement Grout: ANSI A118.6.

C. High-Performance Tile Grout: ANSI A118.7.

1. Polymer Type: Dry, redispersible form, prepackaged with other dry ingredients.

2.08 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; stainless steel, ASTM A666, 300 Series exposed-edge material.

1. Basis-of-Design Product: Schluter "DILEX-AHK" Item AHK1S100AE Satin aluminum "CB-1", profile tile strip system for tile corners, and caps. "Dilex" cove-shaped profile strip for tile base.

2. Or preapproved equal

C. Floor Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.

2. Verify that concrete substrates for tile floors installed with adhesives, bonded mortar bed or thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

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

3.02 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with adhesives or thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4-inch per foot (1:50) toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.03 INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
 - 1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
 - a. Tile floors in wet areas.
 - b. Tile floors consisting of tiles 8- by 8-inch (200- by 200-mm) or larger.
 - c. Tile floors consisting of rib-backed tiles.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Where accent tile differs in thickness from field tile, vary setting bed thickness so that tiles are flush.
- F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
- G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - 1. Porcelain Wall Tile: Shall not exceed 1/8-inch (3.2-mm).
 - 2. Porcelain Floor Tile: Shall not exceed 1/8-inch (3.2-mm).

- H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 - 1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
- J. Metal Edge Strips: Install at locations indicated.
- K. Floor Sealer: Apply floor sealer to grout joints in tile floors according to floor-sealer manufacturer's written instructions. As soon as floor sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.
- L. Install tile backing panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use modified dry-set mortar for bonding material unless otherwise directed in manufacturer's written instructions.
- M. Install waterproof membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.

3.04 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations, Concrete Subfloor:
 - 1. Ceramic Tile Installation: TCNA F113; thinset mortar.
 - a. Ceramic Tile Type: Refer to drawings.
 - b. Thinset Mortar: Modified dry-set mortar.
 - c. Grout: High-performance unsanded grout.
 - 2. Ceramic Tile Installation: TCNA F122; thinset mortar on waterproof membrane.
 - a. Ceramic Tile Type: Refer to drawings.
 - b. Thinset Mortar: Modified dry-set mortar.
 - c. Grout: High-performance unsanded grout.
- B. Interior Wall Installations, Masonry or Concrete:
 - 1. Ceramic Tile Installation: TCNA W202; thinset mortar.
 - a. Ceramic Tile Type: Refer to drawings.
 - b. Thinset Mortar: Modified dry-set mortar.
 - c. Grout: High-performance unsanded grout.
- C. Interior Wall Installations, Metal Studs or Furring:
 - 1. Ceramic Tile Installation: TCNA W244C or TCNA W244F; thinset mortar on cementitious backer units or fiber-cement backer board.
 - a. Ceramic Tile Type: Refer to drawings.

- b. Thinset Mortar: Modified dry-set mortar.
 - c. Grout: High-performance unsanded grout.
- 2. Ceramic Tile Installation: TCNA W245 or TCNA W248; thinset mortar on glass-mat, water-resistant gypsum backer board.
 - a. Ceramic Tile Type: Refer to drawings.
 - b. Thinset Mortar: Modified dry-set mortar.
 - c. Grout: High-performance unsanded grout.

END OF SECTION

SECTION 09 51 23
ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Acoustical tiles for interior ceilings.
 - 2. Fully concealed, direct-hung, suspension systems.

1.02 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.
- C. Delegated-Design Submittal: For seismic restraints for ceiling systems.
 - 1. Include design calculations for seismic restraints including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, and coordinated with each other, using input from installers of the items involved.
- B. Product test reports.
- C. Research reports.
- D. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

- A. Maintenance data.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer to design seismic restraints for ceiling systems.
- B. Seismic Performance: Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

- C. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Class A according to ASTM E1264.
2. Smoke-Developed Index: 450 or less.

2.02 ACOUSTICAL TILES

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

1. Armstrong World Industries, Inc.
2. CertainTeed Corporation.
3. Rockfon, a subsidiary of ROCKWOOL International.
4. USG Corporation.
5. Or pre-approved equal

- B. Basis-of-Design Product: Armstrong Ultima High NRC" - Item 1942 (**ACT-1**)

1. Classification: Type IV, Form 2, Pattern E
2. LR: 0.88
3. NRC: 0.80
4. CAC: 35
5. Fire Performance: ASTM E84 Flame Spread Index 25 or less, Smoke Developed Index 50 or less. Fire Class A; fire-resistive ceiling when used in applicable UL assemblies (Class A).
6. Edge/Joint Detail: 9/16 inch, Beveled Tegalur.
7. Thickness: Minimum 7/8-inch (22-mm).
8. Modular Size: 24-inch x 24-inch x 7/8 inch (609-mm x 609-mm x 22.225 mm).
9. Suspension System: Prelude® XL® 9/16" Fire Guard Exposed Tee.
10. Color: White (WH).

2.03 METAL SUSPENSION SYSTEM

- A. Metal Suspension-System Standard: Manufacturer's standard, direct-hung, fully concealed, metal suspension system that complies with applicable requirements in ASTM C635/C635M.

- B. Direct-Hung, Double-Web Suspension System: Main and cross runners roll formed from and capped with cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 (Z90) coating designation.

1. Structural Classification: Heavy-duty system.
2. Access: Upward and end pivoted or side pivoted, with initial access openings of size indicated below and located throughout ceiling within each module formed by main and cross runners, with additional access available by progressively removing remaining acoustical tiles.

- a. Initial Access Opening: In each module, 24- by 24-inch (610- by 610-mm).

2.04 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

- B. Hold-Down Clips: Manufacturer's standard hold-down. Confirm installation locations with Owner.
- C. Pre-formed closers matching edge molding shall be used at round penetrations or obstructions.

2.05 METAL EDGE MOLDINGS AND TRIM

- A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
 - 1. Basis-of-Design: Armstrong "AXIOM Classic – 2 inch" - Item AX2STRWH.
 - a. Components:
 - 1) Straight Perimeter Trim.
 - 2) Outside 90° Corner.
 - 3) All additional parts as required for complete installation.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders unless otherwise indicated.
- B. Layout openings for penetrations centered on the penetrating items.

3.02 INSTALLATION OF SUSPENDED ACOUSTICAL TILE CEILINGS

- A. Install suspended acoustical tile ceilings according to ASTM C636/C636M, seismic design requirements, and manufacturer's written instructions.
- B. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical tiles.
 - 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 - 2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- C. Arrange directionally patterned acoustical tiles as indicated on reflected ceiling plans.

3.03 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform inspections:
 - 1. Periodic inspection during the installation of suspended ceiling grids according to ASCE/SEI 7.

END OF SECTION

SECTION 09 65 13

RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Thermoset-rubber base.
 - 2. Thermoplastic-rubber base.
 - 3. Rubber molding accessories.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.01 THERMOPLASTIC-RUBBER BASE (**RB-1**)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Burke Flooring, a Division of Burke Industries Inc.
 - 2. Flexco.
 - 3. Roppe Corporation, USA.
 - 4. Or pre-approved equal.
- B. Product Standard: ASTM F1861, Type TP (rubber, thermoplastic).
 - 1. Group: I (solid, homogeneous) or II (layered).
 - 2. Style and Location:
 - a. **RB-1**: Roppe 700 Series - 193 Black Brown.
 - b. Style A, Straight: Provide in areas with carpet.
- C. Thickness: 0.125-inch (3.2-mm).
- D. Height: 4-inch (102-mm).
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Preformed.
- G. Inside Corners: Preformed.
- H. Colors: As selected by Architect from manufacturer's full range.

2.02 RUBBER MOLDING ACCESSORY

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Burke Flooring, a Division of Burke Industries Inc.
 - 2. Flexco.
 - 3. Roppe Corporation, USA.
 - 4. Or pre-approved equal.
- B. Description: Rubber carpet edge for glue-down applications, nosing for resilient floor covering, reducer strip for resilient floor covering, joiner for tile and carpet and transition strips.
- C. Profile and Dimensions: As indicated.
- D. Locations: Provide rubber molding accessories in areas indicated.
- E. Colors and Patterns: As selected by Architect from manufacturer's full range.

2.03 INSTALLATION MATERIALS

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

PART 3 - EXECUTION

3.01 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until materials are the same temperature as space where they are to be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.02 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.

3.03 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.04 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION

SECTION 09 68 13

TILE CARPETING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Modular carpet tile.

1.02 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For carpet tile installation, plans showing the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Carpet tile type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.
5. Pattern of installation.
6. Pattern type, location, and direction.
7. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

C. Samples: For each exposed product and for each color and texture required.

1.04 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Sample warranty.

1.05 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

1.07 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 CARPET TILE

- A. Manufacturers:

1. Interface, LLC.
2. J&J Invision; J&J Industries, Inc.
3. Mannington Mills, Inc.
4. Milliken & Company.
5. Mohawk Group (The); Mohawk Carpet, LLC.
6. Shaw Contract Group; a Berkshire Hathaway company.
7. Or pre-approved equal.

- B. Basis-of- Design Product: Mohawk "Solve II - Iridescent 955".

- C. Color: As selected by Architect from manufacturer's full range.

- D. Pattern: Match Architect's samples.

- E. Fiber Content: 100 percent nylon 6, 6.

- F. Pile Characteristic: Tufted.

- G. Density: 6,990 oz/cu. yd. (259.187 g/m³).

- H. Pile Thickness: 0.1-inch for finished carpet tile.

- I. Stitches per inch: 12 per inch (47.24 per 10 cm).

- J. Gage: 1/12-inch (47.00 rows per 10 cm).

- K. Surface Pile Weight: 17 oz./sq. yd. (576 g/m²).

- L. Primary Backing: Unibond® Plus.

- M. Width: 12 foot width (3.66-m).

- N. Applied Treatments:

1. Soil-Resistance Treatment: Manufacturer's standard treatment.
2. Antimicrobial Treatment: Manufacturer's standard treatment that protects carpet tiles as follows:

- a. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.

O. Performance Characteristics:

- 1. Appearance Retention Rating: Severe traffic, 3.5 minimum according to ASTM D7330.
- 2. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm according to NFPA 253.
- 3. Dry Breaking Strength: Not less than 100 lbf (445 N) according to ASTM D2646.
- 4. Dimensional Tolerance: Within 1/32-inch (0.8-mm) of specified size dimensions, as determined by physical measurement.
- 5. Dimensional Stability: 0.2 percent or less according to ISO 2551 (Aachen Test).
- 6. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.
- 7. Colorfastness to Light: Not less than 4 after 60 AFU (AATCC fading units) according to AATCC 16, Option E.
- 8. Electrostatic Propensity: Less than 3.0 kV according to AATCC 134.

2.02 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

PART 3 - EXECUTION

3.01 PREPARATION

- A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8-inch (3-mm) wide or wider, and protrusions more than 1/32-inch (0.8-mm) unless more stringent requirements are required by manufacturer's written instructions.
- C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.
- D. Metal Substrates: Clean grease, oil, soil and rust, and prime if recommended in writing by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.
- E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.02 INSTALLATION

- A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: As recommended in writing by carpet tile manufacturer.
- C. Maintain dye-lot integrity. Do not mix dye lots in same area.
- D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
- G. Install pattern parallel to walls and borders.
- H. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 - 2. Remove yarns that protrude from carpet tile surface.
 - 3. Vacuum carpet tile using commercial machine with face-beater element.
- I. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION

SECTION 09 91 23

INTERIOR PAINTING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes surface preparation and the application of paint systems on interior substrates.
 - 1. Concrete.
 - 2. Steel and iron.
 - 3. Galvanized metal.
 - 4. Aluminum (not anodized or otherwise coated).
 - 5. Wood.
 - 6. Gypsum board.

1.02 DEFINITIONS

- A. MPI Gloss Level 1 (Matte, Flat): Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.
- B. MPI Gloss Level 2 (Velvet, Flat): Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- C. MPI Gloss Level 3 (Eggshell): 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- D. MPI Gloss Level 4 (Satin): 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
- E. MPI Gloss Level 5 (Semi-Gloss): 35 to 70 units at 60 degrees, according to ASTM D523.
- F. MPI Gloss Level 6 (Gloss): 70 to 85 units at 60 degrees, according to ASTM D523.
- G. MPI Gloss Level 7 (High Gloss): More than 85 units at 60 degrees, according to ASTM D523.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
- B. Samples: For each type of paint system and in each color and gloss of topcoat.

1.04 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in the Interior Painting Schedule for the paint category indicated.
 1. Basis-of-Design Manufacturer: Dunn-Edwards Corp.; or preapproved equal.

2.02 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Material Compatibility:
 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. Colors: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 1. Concrete: 12 percent.
 2. Wood: 15 percent.
 3. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.02 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

3.03 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
- B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.04 INTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Nontraffic Surfaces:
 1. Latex System:
 - a. Prime Coat: Primer sealer, latex, interior.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior (Gloss Level 3).
 2. Institutional Low-Odor/VOC Latex System:
 - a. Prime Coat: Primer sealer, interior, institutional low odor/VOC.
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - c. Topcoat: Latex, interior, institutional low odor/VOC (Gloss Level 3).
 3. Premium Institutional Low-Odor/VOC Latex System:
 - a. Prime Coat: Primer sealer, interior, institutional low odor/VOC.
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - c. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss, (Gloss Level 5).
 4. Premium Architectural Coating System:
 - a. Prime Coat: Primer, alkali resistant, water based.
 - b. Intermediate Coat: Premium Architectural Coating, interior, water based, matching topcoat.
 - c. Topcoat: Acrylic, interior, water-based, semi-gloss, (MPI Gloss Level 5).
 5. Alkyd System:
 - a. Prime Coat: Primer, alkali resistant, water based.

- b. Intermediate Coat: Alkyd, interior, matching topcoat.
- c. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5).

B. Steel Substrates:

1. Latex System, Alkyd Primer System:

- a. Prime Coat: Primer, alkyd, anti-corrosive, for metal.
- b. Prime Coat: Primer, alkyd, quick dry, for metal.
- c. Intermediate Coat: Latex, interior, matching topcoat.
- d. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5).

2. Water-Based Dry-Fall System:

- a. Prime Coat: Primer, alkyd, quick dry, for metal.
- b. Prime Coat: Primer, alkyd, anti-corrosive, for metal.
- c. Prime Coat: Shop primer specified in Section where substrate is specified.
- d. Topcoat: Dry fall, latex, semi-gloss (MPI Gloss Level 5).

3. Institutional Low-Odor/VOC Latex System:

- a. Prime Coat: Primer, rust inhibitive, water based.
- b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
- c. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5).

4. Premium Architectural Coating System:

- a. Prime Coat: Primer, rust-inhibitive, water based.
- b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
- c. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5).

5. Alkyd System:

- a. Prime Coat: Shop primer specified in Section where substrate is specified.
- b. Intermediate Coat: Alkyd, interior, matching topcoat.
- c. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5).

6. Quick-Dry Enamel System:

- a. Prime Coat: Primer, alkyd, quick dry, for metal.
- b. Intermediate Coat: Alkyd, quick dry, matching topcoat.
- c. Topcoat: Alkyd, quick dry, semi-gloss (MPI Gloss Level 5).

C. Galvanized-Metal Substrates:

1. Latex System:

- a. Prime Coat: Primer, galvanized, water based.
- b. Intermediate Coat: Latex, interior, matching topcoat.
- c. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5).

2. Water-Based Dry-Fall System:
 - a. Topcoat: Dry fall, water based, flat, (MPI Gloss Level 1).
 - b. Topcoat: Dry fall, water based, low sheen, (MPI Gloss Level 3).
 3. Institutional Low-Odor/VOC Latex System:
 - a. Prime Coat: Primer, galvanized, water based.
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - c. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5).
 4. Premium Architectural Coating Over Waterborne Primer System:
 - a. Prime Coat: Primer, galvanized, water based.
 - b. Intermediate Coat: Premium Architectural Coating, interior, water based, matching topcoat.
 - c. Topcoat: Acrylic, interior, water based, semi-gloss, (MPI Gloss Level 5).
- D. Aluminum (Not Anodized or Otherwise Coated) Substrates:
1. Latex System:
 - a. Prime Coat: Primer, quick dry, for aluminum.
 - b. Primer Coat: Primer, water based.
 - c. Intermediate Coat: Latex, interior, matching topcoat.
 - d. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5).
 2. Institutional Low-Odor/VOC Latex System:
 - a. Prime Coat: Primer, quick dry, for aluminum.
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - c. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5).
 3. High-Performance Architectural Latex System:
 - a. Prime Coat: Primer, quick dry, for aluminum.
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - c. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5).
 4. Water-Based Light Industrial Coating System:
 - a. Prime Coat: Primer, quick dry, for aluminum.
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5).
 5. Alkyd System:
 - a. Prime Coat: Primer, water based.
 - b. Prime Coat: Primer, quick dry, for aluminum.
 - c. Intermediate Coat: Alkyd, interior, matching topcoat.

- d. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5).
- E. Wood Substrates: Including wood doors.
 - 1. Latex over Latex Primer System:
 - a. Prime Coat: Primer, latex, for interior wood.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5).
 - 2. Latex over Alkyd Sealer System:
 - a. Prime Coat: Primer sealer, alkyd, interior.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5).
 - 3. Institutional Low-Odor/VOC Latex System:
 - a. Prime Coat: Primer, latex, for interior wood.
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - c. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5).
 - 4. High-Performance Architectural Latex System:
 - a. Prime Coat: Primer, latex, for interior wood.
 - b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - c. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5).
 - 5. Alkyd over Alkyd Sealer System:
 - a. Prime Coat: Primer sealer, alkyd, interior.
 - b. Intermediate Coat: Alkyd, interior, matching topcoat.
 - c. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5).
- F. Gypsum Board Substrates:
 - 1. Latex over Latex Sealer System:
 - a. Prime Coat: Primer sealer, latex, interior.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, semi-gloss (MPI Gloss Level 5).
 - 2. Institutional Low-Odor/VOC Latex System:
 - a. Prime Coat: Primer sealer, interior, institutional low odor/VOC.
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - c. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5).
 - 3. High-Performance Architectural Latex System:
 - a. Prime Coat: Primer sealer, latex, interior.

- b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
 - c. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5).
- 4. Alkyd over Latex Sealer System:
 - a. Prime Coat: Primer sealer, latex, interior.
 - b. Intermediate Coat: Alkyd, interior, matching topcoat.
 - c. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5).

END OF SECTION

SECTION 10 14 23.16

ROOM-IDENTIFICATION PANEL SIGNAGE

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes room-identification signs that are directly attached to the building.

1.02 ACTION SUBMITTALS

- A. Comply with City of Chandler Graphic Standards Guidelines.
- B. Product Data: For each type of product.
- C. Shop Drawings: For room-identification signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
 - 3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign.
- D. Samples: For each exposed product and for each color and texture specified.

1.03 INFORMATIONAL SUBMITTALS

- A. Sample warranty.

1.04 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.05 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

2.02 ROOM-IDENTIFICATION SIGNS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. APCO Graphics, Inc.
 - 2. ASI Sign Systems, Inc.
 - 3. Best Sign Systems Inc.
 - 4. InPro Corporation.
 - 5. Mohawk Sign Systems.
 - 6. Seton Identification Products.
 - 7. Or pre-approved equal.
- B. Room-Identification Sign: Sign system with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
 - 1. Laminated-Sheet Sign: Photopolymer face sheet with raised graphics laminated over subsurface graphics to acrylic backing sheet to produce composite sheet.
 - a. Composite-Sheet Thickness: Manufacturer's standard for size of sign.
 - b. Color(s): As selected by Architect from manufacturer's full range.
 - 2. Sign-Panel Perimeter: Finish edges smooth.
 - a. Edge Condition: Square cut.
 - b. Corner Condition in Elevation: Square.
 - 3. Mounting: Manufacturer's standard method for substrates indicated with concealed anchors.

2.03 SIGN MATERIALS

- A. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- B. Vinyl Film: UV-resistant vinyl film with pressure-sensitive, permanent adhesive; die cut to form characters or images as indicated on Drawings.

2.04 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
 - 1. Use concealed fasteners and anchors unless indicated to be exposed.
 - 2. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.
 - 3. Exposed Metal-Fastener Components, General:
 - a. Fabricated from same basic metal and finish of fastened sign unless otherwise indicated.
 - 4. Sign Mounting Fasteners:

- a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly unless otherwise indicated.
 - b. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, and installed in predrilled holes.
 - B. Adhesive: As recommended by sign manufacturer.
 - C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045-inch (1.14-mm) thick, with adhesive on both sides.
- 2.05 FABRICATION
- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 - 1. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 - 2. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 - 3. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
 - B. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.
 - C. Subsurface-Etched Graphics: Reverse etch back face of clear face-sheet material. Fill resulting copy with manufacturer's standard enamel. Apply opaque manufacturer's standard background color coating over enamel-filled copy.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
 - 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Mounting Methods:
 - 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

2. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
3. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
4. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

END OF SECTION

SECTION 10 26 00
WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Wall guards.
2. Corner guards.

B. Related Requirements:

1. Section 08 71 00 "Door Hardware" for metal and plastic protective trim units, according to BHMA A156.6, used for armor, kick, mop, and push plates.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of wall and door protection showing locations and extent.

1. Include plans, elevations, sections, and attachment details. Show handrail design and support spacing required to withstand structural loads.

C. Samples: For each exposed product and for each color and texture specified, 12-inch (300-mm) long.

1.03 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Material certificates.

C. Sample warranty.

1.04 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.05 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Surface Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1.

2.02 WALL GUARDS

- A. Crash Rail: Heavy-duty, PVC-free assembly consisting of continuous snap-on plastic cover installed over concealed retainer; designed to withstand impacts.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Floor Products Co., Inc.
 - b. Construction Specialties, Inc.
 - c. IPC Door and Wall Protection Systems; Division of InPro Corporation.
 - d. Korogard Wall Protection Systems; a division of RJF International Corporation.
 - e. Musson Rubber Company.
 - f. Pawling Corporation.
 - g. Tepromark International, Inc.
 - h. Or pre-approved equal.
 - 2. Cover: Extruded rigid plastic, minimum 0.100-inch (2.5-mm) wall thickness; in dimensions and profiles indicated on Drawings.
 - a. Surface: Uniform.
 - b. Color and Texture: As selected by Architect from manufacturer's full range.
 - 3. Continuous Retainer: Minimum 0.080-inch (2.0-mm) thick, one-piece, extruded aluminum.
 - 4. Retainer Clips: Manufacturer's standard impact-absorbing clips designed for heavy-duty performance.
 - 5. Bumper: Continuous, resilient bumper cushion(s).
 - 6. End Caps and Corners: Prefabricated, injection-molded plastic; matching color cover; field adjustable for close alignment with snap-on cover.
 - 7. Accessories: Concealed splices and mounting hardware.
 - 8. Mounting: Surface mounted directly to wall.

2.03 CORNER GUARDS

- A. Surface-Mounted, Metal Corner Guards: Fabricated as one piece from formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.
 - 1. Material: Stainless-steel sheet, Type 304.

- a. Thickness: Minimum 0.0781-inch (2.0-mm).
 - b. Finish: Directional satin, No. 4.
- 2. Wing Size: Nominal 1-1/2- by 1-1/2-inches (38- by 38-mm).
- 3. Corner Radius: 1/8-inch (3-mm).
- 4. Mounting: Flat-head, countersunk screws through factory-drilled mounting holes.
- B. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required, thickness as indicated.
- C. Polycarbonate Plastic Sheet: ASTM D6098, S-PC01, Class 1 or Class 2, abrasion resistant; with a minimum impact-resistance rating of 15 ft.-lbf/in. (800 J/m) of notch when tested according to ASTM D256, Test Method A.
- D. 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.
- E. Adhesive: As recommended by protection product manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- B. Mounting Heights: Install wall and door protection in locations and at mounting heights indicated on Drawings.
- C. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.
 - 1. Provide anchoring devices and suitable locations to withstand imposed loads.
 - 2. Where splices occur in horizontal runs of more than 20-feet (6.1-m), splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12-inch (305-mm) apart.
 - 3. Adjust end and top caps as required to ensure tight seams.

END OF SECTION

SECTION 10 28 00

TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Employee and Public-use washroom accessories.
 - 2. Underlavatory guards.

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: Full size, for each exposed product and for each finish specified.

1.03 INFORMATIONAL SUBMITTALS

- A. Sample warranty.

1.04 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.05 WARRANTY

- A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 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.

2.02 EMPLOYEE AND PUBLIC-USE WASHROOM ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Specialties, Inc.
 - 2. Bobrick Washroom Equipment, Inc.
 - 3. Bradley Corporation.
 - 4. Or pre-approved equal.
 - 5. Products in this section are based on products manufactured by Bobrick Washroom Specialties, Inc. in order to establish a level of quality.

B. Toilet Tissue (Roll) Dispenser (**TP1**):

1. Basis-of-Design Product: Bobrick B-2888.
2. Description: Multi-roll toilet tissue dispenser.
3. Mounting: Surface mounted.
4. Capacity: Designed for up to 2 standard toilet tissue rolls.
5. Material and Finish: 22 gauge stainless steel with satin finish.
6. Lockset: Tumbler type.

C. Combination Towel/Waste Units (**TWC1**):

1. Basis-of-Design Product: Bobrick B-3944.
2. Mounting: Semi-Recessed.
3. Minimum Capacity: 600 C-fold or 800 multifold towels.
4. Waste Receptacle: 12 gallon.
5. Material and Finish: Stainless steel, No. 4 finish (satin).
6. Lockset: Tumbler type.

D. Liquid-Soap Dispenser (**SD2**):

1. Basis-of-Design Product: Waxie 385840.
2. Description: Designed for dispensing foam soap.
3. Mounting: Vertically oriented, surface mounted.
4. Capacity: 1250 ml
5. Plastic.
6. Refill Indicator: Window type

E. Sanitary-Napkin Disposal Unit (**SN1**):

1. Basis-of-Design Product: Bobrick B-270.
2. Mounting: Surface mounted.
3. Door or Cover: Self-closing, disposal-opening cover and hinged face panel with tumbler lockset.
4. Receptacle: Removable.
5. Material and Finish: Stainless steel, No. 4 finish (satin).

F. Seat-Cover Dispenser (**SC1**):

1. Basis-of-Design Product: Bobrick Contura.
2. Mounting: Surface mounted on wall or partition.
3. Minimum Capacity: 250 seat covers.
4. Exposed Material and Finish: 20 gauge stainless steel, No. 4 finish (satin).
5. Concealed opening in bottom.

G. Mirror Unit (**M1**):

1. Basis-of-Design Product: Bobrick B-165-1848.
2. Frame: Stainless-steel channel.
 - a. Corners: Welded and ground smooth.
3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.

- a. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
- 4. Size: 18-inch by 48-inch unless indicated otherwise.
- H. Grab Bar (**GB1**):
 - 1. Basis-of-Design Product: Bobrick B-6806.
 - 2. Mounting: Flanges with concealed fasteners.
 - 3. Material: Stainless steel, 0.05-inch thick.
 - a. Finish: Smooth, No. 4 finish (satin).
 - 4. Outside Diameter: 1-1/2-inch.
 - 5. Configuration and Length: As indicated on Drawings.

2.03 UNDERLAVATORY GUARDS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Plumberex Specialty Products, Inc.
 - 2. Truebro by IPS Corporation.
 - 3. Or preapproved equal.
- B. Underlavatory Guard:
 - 1. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
 - 2. Material and Finish: Antimicrobial, molded plastic, white.

2.04 FABRICATION

- A. 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. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F446.

END OF SECTION

SECTION 10 44 13
FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Fire-protection cabinets for portable fire extinguishers.

1.02 PREINSTALLATION CONFERENCE

- A. Preinstallation Conference: Conduct conference at Project site.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For fire-protection cabinets.
- C. Samples: For each type of exposed finish required.

1.04 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.05 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.

2.02 FIRE-PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
 - 1. Manufacturer's: Subject to compliance with requirements, provide one of the following:
 - a. Fire-End & Croker Corporation.
 - b. Guardian Fire Equipment, Inc.
 - c. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - d. Larsens Manufacturing Company.

- e. Modern Metal Products, Division of Technico Inc.
- f. Nystrom, Inc.
- g. Potter Roemer LLC.
- h. Or pre-approved equal.

B. Cabinet Construction: Nonrated and One-hour fire rated (where indicated).

- 1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch (1.09-mm) thick cold-rolled steel sheet lined with minimum 5/8-inch (16-mm) thick fire-barrier material. Provide factory-drilled mounting holes.

C. Cabinet Material: 12 gauge cold-rolled steel finished with rust inhibitive baked primer

D. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).

- 1. Square-Edge Trim: 1-1/4- to 1-1/2-inch (32- to 38-mm) backbend depth.
- 2. Rolled-Edge Trim: 2-1/2-inch (64-mm) backbend depth.

E. Cabinet Trim Material: Same material and finish as door.

F. Door Material: Steel sheet.

G. Door Style: Fully glazed panel with frame and full acrylic bubble with frame.

H. Door Glazing: Tempered float glass (clear).

- 1. Acrylic Sheet Color: Clear transparent acrylic sheet.
- 2. Acrylic Sheet Color: Clear transparent acrylic sheet painted red on unexposed side.
- 3. Acrylic Bubble Color: Clear, transparent.

I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

J. Accessories:

- 1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
- 2. Break-Glass Strike: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.
- 3. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.
- 4. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
- 5. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.
 - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
 - 1) Location: Applied to cabinet door.
 - 2) Application Process: Decals.
 - 3) Lettering Color: Red.

4) Orientation: As indicated on Drawings.

K. Materials:

1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.
 - a. Finish: Baked enamel or powder coat..
 - b. Color: As selected by Architect from manufacturer's full range.
2. Clear Float Glass: ASTM C1036, Type I, Class 1, Quality q3, 6 mm thick.
3. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).
4. Transparent Acrylic Sheet: ASTM D4802, Category A-1 (cell-cast sheet), 3-mm thick, with Finish 1 (smooth or polished).

2.03 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Prepare recesses for semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.
- B. Install fire-protection cabinets in locations and at mounting heights indicated.
- C. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
- D. Identification: Apply decals at locations indicated.
- E. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

END OF SECTION

SECTION 10 44 16
FIRE EXTINGUISHERS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.02 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.03 ACTION SUBMITTALS

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

1.04 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.06 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.07 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

- 1. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.02 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Badger Fire Protection.
 - b. Buckeye Fire Equipment Company.
 - c. JL Industries, Inc.; a division of the Activar Construction Products Group.
 - d. Larsens Manufacturing Company.
 - e. Potter Roemer LLC.
 - f. Or pre-approved equal.
 - 2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.
- B. Multipurpose Dry-Chemical Type: UL-rated 5-lb (2.3-kg) nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

2.03 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
 - 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
 - a. Orientation: Vertical.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
 - 1. Mounting Brackets: Top of fire extinguisher to be at 42-inch (1067-mm) above finished floor.
- C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION

SECTION 12 21 13
HORIZONTAL LOUVER BLINDS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Horizontal Blinds as shown on the Drawings and as specified.

1.02 SUBMITTALS

- A. Samples: Submit samples of blind materials, colors and patterns.

1.03 DELIVERY, STORAGE AND HANDLING

- A. Packing and Shipping: Deliver materials to site in Manufacturer's original unopened packaging with labels intact.
- B. Storage and Protection: Adequately protect against damage while stored at the site.
- C. Handling: Comply with Manufacturer's instructions.

1.04 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions shown on Drawings by taking field measurements; proper fit and attachment of parts is required.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Furnish products of one of the following Manufacturers, unless prior approved by the Architect, subject to compliance with Specification requirements:
 - 1. Levelor Corporation.
 - 2. Hunter Douglas Architectural.
 - 3. Carey-McFall Corporation (Bali), Div. Springs Industries.

2.02 HORIZONTAL MINI-BLINDS

- A. Basis-of-Design Product: Bali "Customiser" Mini Blinds.
 - 1. Headrail: 0.025 inch (0.635mm) thick "U" shaped phosphate treated steel, 1 inch high x 1 inches wide (25mm high x 25mm wide). Enclose hardware in metal headrail.
 - 2. Tilter Mechanism: 0.042 inch (1.07mm) thick steel housing with a self-lubricating nylon, automatically disengaging worm and gear mechanism to eliminate overdrive.
 - 3. Tilt Rod: Electr-zinc coated solid steel, 1/4 inch (6mm) square.
 - 4. Tilt Wands: Transparent with a hexagonal cross section 1/4 inch (6mm) across flats.
 - 5. Cord Lock: 0.042 inch (1.07mm) thick steel and shall be crash proof.
 - 6. Drum and Cradle: Low-friction thermoplastic and provided for each ladder.

7. Brackets: Minimum 0.048 inch (1.22mm) thick phosphate treated steel with a rivet-hinged safety locking front cover.
8. Ladders (slat supports): Distance between slats shall not exceed 14.2 slats per vertical foot (22.5mm).
9. Slats: 5000 Series cold-rolled aluminum. Nominally 0.5 inches (12.5 mm) wide, and 0.006 inch (0.15mm) thick. Slats shall be unperforated.
10. Bottom rail: 0.025 inch (0.64mm) thick phosphate treated steel.
11. Color as selected by Architect from manufacturer's full color range.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Examine subsurfaces to receive Work and report detrimental conditions in writing to Architect. Commencement of Work will be construed as acceptance of subsurfaces.
- B. Coordination with other Work: Coordinate with other Work which affects, connects with, or will be concealed by this Work.

3.02 INSTALLATION

- A. Install window blinds in strict accordance with Manufacturer's instructions. Install straight and plumb, securely fastened, and with horizontal lines level and true with window framing.
- B. Evidence of drilling, cutting and fitting to room finish shall be concealed in the finish work. Provide uniform clearance at edges not to exceed 3/16 inch (5mm). Adjust hardware for smooth operation.
- C. Install blinds between vertical window mullions with discontinuous head channel and slats, allowing independent blind operation for separate glazing units.

3.03 CLEANING

- A. During the course of the Work and on completion, remove and dispose of excess materials, equipment and debris away from premises. Leave Work in clean condition.

END OF SECTION

SECTION 12 36 61.19

QUARTZ AGGLOMERATE COUNTERTOPS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Quartz agglomerate countertops, backsplashes, and end splashes.

1.02 ACTION SUBMITTALS

- A. Product Data: For countertop materials.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
- C. Samples: For each type of material exposed to view.

PART 2 - PRODUCTS

2.01 QUARTZ AGGLOMERATE COUNTERTOP MATERIALS

- A. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with ICPA SS-1, except for composition.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cactus Stone, Phoenix, AZ.
 - 2. E. I. du Pont de Nemours and Company.
 - 3. Meganite, Inc.
 - 4. Technistone USA, Inc.
 - 5. Or pre-approved equal.
- C. Basis-of-Design: Cactus Stone "Quantra."
 - 1. Quartz agglomerate - countertops.
 - 2. Colors and Patterns: As selected by Architect from manufacturer's full color range.
- D. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.02 COUNTERTOP FABRICATION

- A. Fabricate countertops according to quartz agglomerate manufacturer's written instructions and the AWI/AWMAC/WI's "Architectural Woodwork Standards."
 - 1. Grade: Custom, unless indicated otherwise.
- B. Configuration:

1. Front: 3/4-inch (19-mm) bullnose, ease/round off all corners.
 2. Backsplash: Radius edge with 3/8-inch (9.5-mm) radius.
 3. End Splash: Matching backsplash.
- C. Countertops: 3/4-inch (19-mm) thick, quartz agglomerate with front edge built up with same material.
- D. Backsplashes: 1/2-inch (12.7-mm) thick, quartz agglomerate.
- E. Joints: Fabricate countertops without joints.
- F. Joints: Fabricate countertops in sections for joining in field.
- G. Cutouts and Holes:
1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

2.03 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by quartz agglomerate manufacturer.
- B. Sealant for Countertops: Comply with applicable requirements in Section 07 92 00 "Joint Sealants."

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer.
- B. Fasten subtops to cabinets by screwing through subtops into corner blocks of base cabinets. Shim as needed to align subtops in a level plane.
- C. Secure countertops to subtops with adhesive according to quartz agglomerate manufacturer's written instructions.
- D. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
- E. Install backsplashes and end splashes by adhering to wall and countertops with adhesive.
- F. Install aprons to backing and countertops with adhesive.
- G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
- H. Apply sealant to gaps at walls; comply with Section 07 92 00 "Joint Sealants."

END OF SECTION

DIVISION 21

FIRE SUPPRESSION

21 05 00	Common Work Results for Fire Suppression
21 05 00	General Provisions
21 05 17	Sleeves & Sleeve Seals for Fire Suppression Piping
21 05 53	Identification for Fire Suppression Piping & Equipment
21 13 00	Fire-Suppression Sprinkler Systems
21 13 13	Wet-Pipe Sprinkler Systems

END OF INDEX



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SECTION 21 05 00
GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SCOPE

- A. Provisions of this section apply to all work specified in all sections under Division 21.
- B. In addition, work in Division 21 is governed by the provisions of the Bidding Requirements, Contract Forms, General Conditions, and all sections in Division 01, General Requirements.
- C. The Contract Documents do not specify exact installation means and methods or Contractor safety procedures. Installation means and methods and safety procedures are the responsibility of the Contractor. No instruction or statement made on the Contract Documents shall be interpreted to shift this responsibility away from the Contractor.
- D. These specifications contain statements which are more definitive or more restrictive than those contained in the General Conditions. Where these statements occur, they shall take precedence over the General Conditions.

1.2 DEFINITIONS

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

1.3 EXAMINATION OF PREMISES

- A. Visit the site, verify all measurements and project conditions, and pay all costs necessary to perform the work.

1.4 FIRE SPRINKLER CONTRACTOR

- A. The Fire Sprinkler Contractor shall hold a current contracting license that has been valid for a minimum of 2 years in the State of Arizona as a fire sprinkler contractor.

1.5 REGULATIONS, PERMITS, FEES, CHARGES, INSPECTIONS

- A. Regulations: Comply with all applicable codes, rules, and regulations.
- B. Fees and Permits: Pay all connection, installation, use, disposal, development, etc., fees and/or charges. Obtain and pay for all required permits and licenses. Refer to Division 01 specifications.
- C. Inspections: All work must be inspected and approved by local authorities. Prior to final approval, furnish the Architect with certificates of inspections and approvals by the local authorities in accordance with Division 01 specifications.

1.6 DRAWINGS AND SPECIFICATIONS

- A. Refer to Division 01 specifications for additional information on submittals and shop drawings.
- B. If a conflict exists on the drawings or between the drawings and specifications, promptly notify the Architect.

1.7 SUBMITTALS

- A. Submittals are for information and coordination only. The Engineer will diligently review the submittals and attempt to verify compliance with the project requirements. Such review, however, does not constitute approval or disapproval or obligation to comply with all project requirements. The submittals are not to be construed to be Contract Documents. Any failure by the Engineer to note a point of non-compliance shall not be construed to be acceptance or approval of the discrepancy.
- B. Plans and calculations must be approved by the Authority Having Jurisdiction before they are submitted to the Engineer for review.
- C. Product Information Sheets: Provide project-specific manufacturer's literature which includes the information required by the Product Data paragraph of the applicable specification section. Where product information sheets show multiple models or options, clearly mark the model and options to be provided.
- D. Assembly: Assemble all required submittal information for each specification section and submit in PDF format.
 - 1. Assemble PDF submittals in one PDF file for each division. Separate and order sections within each file by corresponding specification number. Provide bookmarks at the first page of each section and label each bookmark with the specification number and name to allow for easy navigation of the submittal.
 - 2. Partial submittals and submittals that are not project specific will be returned without review.
- E. Identification and Information:
 - 1. Name the PDF file with the project name, division number and sequential submittal number (i.e., the first submittal shall be No. 1; the second submittal shall be No. 2).
 - 2. Provide a cover sheet at the front of each submittal with the following information:
 - a. Project name.
 - b. Date.
 - c. Name of Engineer.
 - d. Name of Contractor.

- e. Name of subcontractor.
 - 3. Provide a cover sheet at the front of each submittal section with the following information:
 - a. Name of supplier.
 - b. Name of manufacturer.
 - c. Number and title of appropriate specification section.
 - d. Drawing number and detail references, as appropriate.
 - e. Other necessary identification.
 - F. Options:
 - 1. Identify options requiring selection by the Engineer.
 - 2. Identify options included with submittal item.
 - G. Deviations: Identify deviations from the Contract Documents on submittals.
 - H. Furnished by Others: This project is to provide a complete and functional system. Where material or labor is indicated in the submittal to be provided "by others," clearly indicate who is providing those items and include information to indicate proper coordination.
- 1.8 MATERIAL SAFETY DATA SHEETS
- A. Provide current Material Safety Data Sheets (MSDS) for all hazardous materials that are proposed for use at the project site.
 - 1. Provide one complete set to the Owner for review and approval a minimum of 1 week prior to the delivery of any hazardous materials to the site.
 - 2. Maintain a second complete set at the project location, readily accessible by both the Owner's personnel and the Contractor's personnel.
- 1.9 REQUEST FOR INFORMATION
- A. Request for Information (RFI):
 - 1. A document submitted by the Contractor requesting clarification of a portion of the Contract Documents, hereinafter referred to as an RFI.
 - 2. A properly-prepared RFI shall include a detailed written statement of the clarification, apparent conflict, or information requested that indicates the specific drawings or specifications in need of clarification and the nature of the clarification requested.
 - a. Drawings shall be identified by drawing number and location on the drawing sheet.
 - b. Specifications shall be identified by section number, page, and paragraph.
 - 3. Include a proposed solution, where appropriate, based on the field conditions and best knowledge of the Contractor.
 - B. Improper or Frivolous RFIs: RFIs which are not properly prepared or that request information which is clearly shown in the Contract Documents will be returned unanswered. Processing time for multiple submissions of improper or frivolous RFIs will be billed at the Engineer's standard hourly rate to the Owner, who may deduct an equal amount from the monies due the Contractor.

1.10 AS-BUILT DRAWINGS

A. As-Built Drawings: Maintain one set of marked-up paper copies of the Contract Drawings.

1. Preparation: Mark As-Built Drawings to show the actual installation where installation varies from that shown originally. Include all equipment, and underground and overhead piping.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Include dimensions both horizontally and vertically to permanent points of reference, accurate within 6 inches. Include descriptors such as "below slab," "above ceiling," etc.
 - c. Record data daily or as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
2. Mark the As-Built Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of As-Built Drawings.
3. Mark the As-Built Drawings with erasable, red colored pencil, or in a digital PDF format using an editor program such as Bluebeam, Adobe Acrobat Professional, or similar. Use other colors to distinguish between changes for different categories of the work at the same location.
4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
5. Update the As-Built Drawings weekly or daily as appropriate for the project size.

B. Format: Identify and date each As-Built Drawing; include the designation "PROJECT AS-BUILT DRAWING" in a prominent location.

1. Organize newly-prepared As-Built Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Identification, as follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT AS-BUILT DRAWINGS."
 - d. Name of Engineer.
 - e. Name of Contractor.
3. Remove or obscure the Engineer's seal and signature from As-Built Drawings.

1.11 RECORD DRAWINGS

A. Record Drawings: Immediately before inspection for Certificate of Substantial Completion, submit final marked-up As-Built Drawings to the Architect for review. When authorized, prepare a full set of corrected Record Drawings of the Contract Drawings, as follows:

1. Utilize the same digital data software program, version, and operating system as for the original Contract Drawings to incorporate changes and additional information previously marked on As-Built Drawings. Delete, redraw, and add details and notations where applicable.
2. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
3. Refer instances of uncertainty to the Architect for resolution.

4. Format: Provide Digital Record Drawing files in both DWG and PDF format. Organize Record Drawing information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.

B. Record Drawings Submittal:

1. Submit Digital Record Drawings and three sets of Record Drawing plots.
2. Plot each drawing file, whether or not changes and additional information were recorded.

1.12 OPERATION AND MAINTENANCE MANUAL

A. Prior to completion of the project, compile a complete equipment Operation and Maintenance Manual for all equipment supplied under Division 21.

B. Schedule:

1. Submit a preliminary copy of the manual not less than 30 days prior to Substantial Completion for review and comment.
2. Submit the final version of the manual not more than 4 weeks after Substantial Completion of the project.

C. Format: Submit manuals in both of the following formats:

1. PDF Electronic Files: Assemble each manual into a single master directory with subdirectories for the individual PDF files for each system and piece of equipment. Provide a table of contents file with hyperlinks to each of the individual PDF files within the subdirectories. Submit on digital media acceptable to the Engineer.
 - a. Name each directory, subdirectory, and document file with applicable item name.
 - b. Enable reviewer comments on draft submittals.
2. Paper Copies: Assemble paper copies in 3-ring binders. Separate and order systems and equipment within each binder. Provide labeled tabs at each section with a table of contents at the front of the binder. The table of contents shall indicate the tab number and the information contained at that tab. Enclose title pages and directories in clear plastic sleeves.

D. Provide Operation and Maintenance Manuals for all systems, subsystems, and equipment that require operation and regular maintenance, or have replaceable parts.

E. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, product data, manufacturer's 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. In addition to requirements in this section, include operation and maintenance data required in individual specification sections.

F. Source Information: List each system, subsystem, and piece of equipment included in the manual, identified by product name and arranged to match the manual's table of contents. For each product, list the name, address, and telephone number of the installer or supplier and maintenance service agent, and cross-reference the specification section number and title in the Project Manual.

- G. Product Data: Include the following information:
1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on the Contract Documents.
 2. Approved submittals.
 3. Include the following if not shown on approved submittals:
 - a. Product name and model number. Use designations for products indicated on the Contract Documents.
 - b. Manufacturer's name.
 - c. Equipment identification with serial number of each component.
 - d. Equipment function.
 - e. Operating characteristics.
 - f. Limiting conditions.
 - g. Performance curves.
 - h. Engineering data and tests.
- H. Operating Procedures: Include the following information, as applicable:
1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures, including precautions against improper use.
 10. Operating logs.
- I. Wiring Diagrams: Diagram of factory-installed wiring, including any options as well as any field modifications.
- J. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- K. Manufacturer's Maintenance Documentation: Include 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.
- L. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
 2. Troubleshooting guide.
 3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.

- M. 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.
- N. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturer's maintenance documentation and local sources of maintenance materials and related services.
- O. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- P. Licenses: Include copies of any licenses with requirements, including inspection and renewal dates.
- Q. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1.13 WORK AND MATERIALS

- A. Unless otherwise specified, all materials must be new and of the quality specified. The workmanship shall be of a quality that is acceptable to the Architect, Engineer, and Owner, and is equal to the standards of the trades. The Contractor must staff the project with sufficient skilled workmen, including a fully-qualified construction superintendent, to complete the work in the time allotted. The superintendent must be qualified to supervise all of the work in his work category.
- B. Uniformity: Unless otherwise specified, provide all equipment and products of the same type or classification by the same manufacturer.

1.14 APPROVALS OF MATERIALS AND EQUIPMENT

- A. Refer to Division 01 specifications for description of material and equipment for prior approvals and substitutions.

1.15 COOPERATIVE WORK

- A. Correct without charge any work requiring alteration due to lack of proper supervision or failure to make proper provision in time. Correct without charge any damage to adjacent work caused by the alteration. Refer to Division 01 specifications for additional requirements.
- B. Cooperative work includes:
 - 1. General supervision and responsibility for proper location, rough-in, and size of work related to Division 21 but provided under other divisions of these specifications.
 - 2. Installation of sleeves, inserts, and anchors bolts for work under sections in Division 21.

1.16 EXISTING MATERIALS AND EQUIPMENT

- A. Disposition: With the exception of items that are to be reused or retained by the Owner, all other materials indicated to be removed shall be removed and legally disposed of by the Contractor. Items that are indicated to be retained or returned to the Owner shall be delivered to a storage area designated by the Owner.

- B. Unused Materials: All unused piping, controls, and miscellaneous materials shall be removed by the Contractor except where located within walls, below or above existing construction which is not being altered and would require removal and replacement of this existing construction. All visible piping, etc., shall be removed and sealed or capped within wall, below floor, or above ceiling unless noted otherwise.
- C. Exterior Services: The Contractor shall be responsible for maintaining fire protection services to the existing building during the construction period. Existing services are to be retained until such a time that the new services, if any, are completely installed and ready for use. Scheduling of service interruptions is to be coordinated with the Architect and Owner.
- D. Disconnect, demolish, and remove fire sprinkler systems, equipment, and components that are indicated to be removed.
 - 1. Piping to be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with the same or compatible piping material. Patch insulation, as required, to match adjacent areas.
 - 2. Piping to be Abandoned in Place: Drain piping and cap or plug piping with the same or compatible piping material.
 - 3. Equipment to be Removed: Disconnect and cap services and remove equipment.
 - 4. Equipment to be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment fixtures operational.
 - 5. Equipment to be Removed and Salvaged: Disconnect and cap services and remove equipment, and deliver to Owner.
- E. Continuity of Services in Existing Building: The Contractor shall permanently reroute existing fire sprinkler services or provide temporary connection as required to maintain service to areas in the building which are to remain in service.
- F. Rerouting and Relocation of Existing Fire Protection Equipment and Services in Existing Building:
 - 1. General: The Contractor shall reroute/relocate all existing materials which are in conflict with the building alterations and which are required to be maintained in use.
 - 2. Existing Piping: Where applicable, existing material may be reused in its original location unless otherwise indicated.
- G. Testing: All existing services affected by the new construction and which are modified, reused, or are to remain in operation shall be returned to their original condition. The existing services shall be tested as new, as described in other sections of these specifications. If for any reason these requirements cannot be met, the Contractor shall immediately notify the Architect.

1.17 CONSTRUCTION FACILITIES

- A. General: Under this division of the specifications, execute all work in a manner to provide safe and lawful ingress and egress to the Owner's establishment, and such facilities shall be kept clear of materials or equipment. Refer to Division 01 specifications for additional requirements.
- B. Furnish and maintain, from the beginning to the completion of all work, all lawful and necessary security, guards, railings, fences, canopies, lights, fire protection, and warning signs. Take all necessary precautions required by city and state laws to avoid injury or damage to any and all persons and property.

1.18 GUARANTEE

- A. Guarantee all material, equipment, installation, and workmanship for all sections under Division 21, in writing, to be free from defects of material and workmanship for 1 year from date of final acceptance as outlined in Division 01 specifications. Equipment warranties shall be a minimum of 1 year from date of Substantial Completion or as specified elsewhere. Replace without charge any material or equipment proving defective during this period. The guarantee shall include performance of the equipment under all conditions.

1.19 ELECTRICAL WORK

- A. Electrical wiring, including power wiring and control wiring, except as otherwise specified under Division 21, all raceways, outlet and junction boxes, and labor for installation of the wiring and equipment shall be included in Division 26 and Division 28 of the specifications.
- B. All loose starters and control devices, except as otherwise specified under Division 21, are to be furnished and installed under Division 26.
- C. Contractor shall be responsible for the checking and testing of all controls and the interlocks for a complete and satisfactory operating system.
- D. Before ordering any motors and equipment, verify the available voltage and phase for all motors with the Division 26 Contractor.
- E. Submit a complete list of all motors prior to final closeout of the project indicating the location, horsepower, voltage, phase, and amperage draw of each motor.
- F. All field wiring and equipment must conform to the applicable Division 26 specification sections.

PART 2 - PRODUCTS

2.1 MACHINERY DRIVES

- A. Unless otherwise specified in Division 21 equipment sections, use V-belts designed for 150% of capacity for all belt drives. For multiple belt drives, use matched sets, so marked at the factory.
- B. On drives with not more than two belts, provide adjustable pitch motor sheaves with the midpoint of the adjustment range equal to that required to achieve the specified fan capacity.
- C. On motors with drives with more than two belts, furnish non-adjustable sheaves providing the specified fan capacity.

2.2 MACHINERY ACCESSORIES

- A. Guards: Provide totally-enclosed OSHA-type belt guards for all rotating equipment. Design guards to be readily removable for access to belt drives.

2.3 EQUIPMENT DESIGN AND INSTALLATION

- A. Design all equipment in accordance with the latest edition of ASME, AGA, UL, and other applicable technical standards as follows:
 - 1. Pressure Vessels: ASME Code constructed and stamped.

2. Electric Appliances: UL labeled.
3. Fire Protection Equipment: UL approved and labeled.

2.4 GROUT

- A. Description: ASTM C1107, Grade B, non-shrink and non-metallic, dry hydraulic-cement grout.
 1. Characteristics: Post-hardening, volume-adjusting, non-staining, non-corrosive, non-gaseous, and recommended for interior and exterior applications.
 2. Design Mix: 5,000-psi, 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SUBMITTALS

- A. Prepare submittals as directed for review by the Contractor, Owner, Architect, and Engineer.
- B. Submit one copy of PDF submittals via email, project website, or other electronic media.

3.2 RECORD DOCUMENTS

- A. Recording: Post changes and modifications to the project Record Documents as they occur; do not wait until the end of the project.
- B. Maintenance of Record Documents and Samples: Store Record Documents in the field office, apart from the Contract Documents used for construction. Do not use project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project Record Documents for the Engineer's reference during normal working hours. As-Built Drawings will be reviewed by the Architect, Owner, and Engineer at each pay request review.
- C. Submit As-Built Drawings to the Architect for approval before completion of Record Drawings.
- D. Secure the Record Drawings in a red-enameled steel cabinet adjacent to the fire sprinkler riser at completion of the project.

3.3 OPERATION AND MAINTENANCE MANUALS

- A. Prepare Operation and Maintenance Manuals as directed.
- B. Submit a preliminary electronic copy of the Operation and Maintenance Manual to the Engineer for review.
- C. Make any corrections noted from the Engineer's review upon receipt of comments and resubmit as required.
- D. Submit the final, corrected Operation and Maintenance Manual in both paper and electronic format to the Architect.

3.4 VERIFICATION OF DIMENSIONS

- A. Scaled and figured dimensions are approximate only. Before proceeding with work, carefully check and verify dimensions at site, and be responsible for properly fitting equipment and materials together and to the structure in spaces provided.
- B. Drawings are essentially diagrammatic and many offsets, bends, special fittings, and exact locations are not indicated. Carefully study drawings and premises in order to determine the best sequence and installation methods, exact locations, routes, and building obstructions, and install apparatus and equipment in available locations. Install apparatus and equipment in a manner and in locations to avoid obstructions, preserve headroom, and keep openings and passageways clear.

3.5 CUTTING AND PATCHING

- A. Cut work and patch per Division 01 specifications as necessary to properly install the new work. As the work progresses, coordinate necessary openings, holes, chases, etc., in their correct location. If the required openings, holes, and chases are not in their correct locations, make the necessary corrections at no cost to the Owner. Avoid excessive cutting and do not cut structural members without the consent of the Architect. Include as a part of the work all structural framing required by penetrations through the roof and necessary design and installation of steel to support pipes between structural steel unless shown on the structural drawings.

3.6 CLOSING IN OF UNFINISHED WORK

- A. Cover no work until inspected, tested, and approved. Where work is covered before inspection and test, uncover it, and when inspected, tested, and approved, restore all work to original proper condition.

3.7 EXCAVATION AND BACKFILL

- A. Perform all necessary excavation, shoring, and backfilling required for the proper laying of all pipes inside the building and premises, and outside as may be necessary. Remove all excess excavated materials from the site or dispose of on site as directed by the General Contractor.
- B. Excavate all trenches open cut, keep trench banks as nearly vertical as practicable, and sheet and brace trenches where required for stability and safety. Excavate trenches true to line and make bottoms not less than 18 inches wide but no wider than necessary to provide ample work room. Excavate to provide continuous granular bedding as indicated. Do not cut any trench near or under footings without first consulting the Architect. Comply with OSHA requirements.
- C. Provide not less than 4 inches of granular material as pipe bedding. Grade and compact trench bedding accurately prior to laying pipe in trench to provide uniform bearing and support for each section of pipe along its entire length. Dig "bell" holes after the trench bottom has been graded and compacted. Granular material shall be pea gravel or sand per MAG Standards.
- D. Provide backfilling and compaction to the required density in accordance with provisions of these specifications and under the direction of the Architect.
- E. Provide not less than 4 inches of granular material, the same as piping bedding, all around pipe. Make the first 2 feet of fill in 6-inch layers, each thoroughly compacted as directed, with no puddling, and free from rocks, large clods of earth, leaves, branches, and debris. Compact the rest of the backfill as directed, using in the backfill no rocks larger than 4 inches in diameter, and using no rock in the top 12 inches.

3.8 ACCESSIBILITY

- A. Install valves, gauges, control devices, or other specialties requiring reading, adjustment, inspection, repairs, removal, or replacement conveniently and accessibly throughout the finished building. Where any of these devices are shown on the Contract Drawings to be installed above any inaccessible ceiling or behind any inaccessible wall, the Fire Sprinkler Contractor shall furnish access doors or panels as required.
- B. All access doors or panels in walls and ceilings required for access to control devices, traps, valves, and similar devices are to be furnished and installed as part of the work under this section. Provide type as specified in Division 08 specifications.
- C. Refer to architectural drawings for type of wall and ceiling in each area and for rated construction.
- D. Coordinate work of various sections to locate valves, etc., with others to avoid unnecessary duplication of access doors.

3.9 FLASHINGS

- A. Flash and counterflash all piping penetrating exterior walls. Refer to architectural drawings for detailing of pipe penetrations through walls.

3.10 PRODUCT AND EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. All equipment, valves, sensors, etc., shall be installed in strict conformance with the manufacturer's recommendations and all codes.
- B. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.
- C. Install equipment and piping level and plumb, parallel and perpendicular to other building systems and components, unless otherwise indicated.
- D. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations.
- E. Install equipment and piping to allow right-of-way for piping installed at required slope.
- F. Do not install any equipment in an application not recommended by the manufacturer.
- G. Provide metal box with red-enamel paint or powder coating mounted on wall adjacent to fire sprinkler riser. Provide a minimum of two spare sprinklers of each type installed within the building and wrenches required to replace sprinklers.
- H. Provide metal box with red-enamel paint or powder coating mounted on wall adjacent to fire sprinkler riser(s). Provide a complete set of fire suppression Record Drawing plots in cabinet.

3.11 EQUIPMENT SUPPORTS

- A. Erection of Metal Supports and Anchorages:
 - 1. Refer to Division 05 specifications for structural steel.

2. Design, cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment. Neatly fabricate and erect steel work with burrs and welding spatter ground off. Paint after fabrication with a rust-inhibitive primer.
 3. Field Welding: Comply with AWS D1.1.
- B. Erection of Wood Supports and Anchorages:
1. Design, cut, fit, and place wood grounds, nailers, blocking, and anchorages to support and anchor plumbing materials and equipment.
 2. 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.
 3. Attach to substrates as required to support applied loads.
- C. Where supports, foundations, stands, suspended platforms for machinery, tanks, or other equipment are indicated or specified, perform the following:
1. Locate support members to avoid equipment strains and interference with piping connections and maintenance operations.
 2. Where saddles are required, use cast-iron or welded-steel saddles with curvature to fit the tank shell.
 3. Mount power-driven equipment on common base with driver.
- D. Concrete Inserts: Furnish and install all concrete inserts required for all materials and equipment specified and/or shown on the drawings for Division 21.
- E. Concrete Housekeeping Pads and Isolation Bases: Work under this section includes coordination of construction of all concrete foundations indicated or required for equipment specified under Division 21. Materials and workmanship shall be described in Division 03 specifications. Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at the project.
1. Construct concrete housekeeping pads and isolation bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 2. Install dowel rods to connect concrete pad to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the pad.
 3. Install epoxy-coated anchor bolts for supported equipment that extends through concrete pad, 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.
- F. Grouting:
1. Grout under all equipment after leveling, filling completely the space between machinery bed plate and foundation surface as specified in Division 03 specifications.
 2. Mix and install grout for plumbing equipment base bearing surfaces, pumps, and other equipment base plates and anchors.
 3. Clean surfaces that will come into contact with grout.
 4. Provide forms as required for placement of grout.
 5. Avoid air entrapment during placement of grout.
 6. Place grout, completely filling equipment bases.

7. Place grout on concrete pads and bases to provide smooth bearing surface for equipment.
8. Place grout around anchors.
9. Cure placed grout.
10. Finish exposed surface of grout for a neat appearance.

3.12 CLEANUP

- A. In addition to cleanup specified in Division 01 specifications, thoroughly clean all parts of the equipment. Where exposed parts are to be painted, thoroughly clean off any splattered construction materials and remove all oil and grease spots. Wipe the surface carefully and scrape out all cracks and corners.
- B. Thoroughly flush and clean all water systems.
- C. During the progress of the work, keep the premises clean and free of debris.

3.13 PAINTING

- A. Except as otherwise specified or indicated in the architectural drawings and/or specifications, paint all exposed, unfinished metal with one coat of rust-inhibiting primer. Stainless-steel, aluminum, and factory-painted equipment shall be considered as having a primed surface.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- C. Finished painting is specified in Division 09 specifications.

3.14 CONNECTIONS TO SERVICES

- A. Provide all connections to water lines, except as otherwise specifically designated. Provide all necessary tees, taps, and connections required to properly connect to building services. Verify all requirements with civil drawings before making any piping connections to water piping and conform to them during installation.

3.15 OBJECTIONABLE NOISE AND VIBRATION

- A. Construct and brace piping systems to prevent vibration or rattling when systems are in operation. Install connections to equipment so that noise and vibration will not reach the conditioned area through piping, conduit, or the building structure.

3.16 WELDING

- A. Procedures:
 1. All procedures and welders must be qualified in accordance with the requirements of Section IX, ASME Boiler and Pressure Vessel Code and ANSI Code B31.1 for power piping. Procedure qualification test records and acceptance shall be submitted with the welding procedure prior to the start of fabrication.
 2. The Architect's inspector or authorized representative will review performance qualification records of individual welders.

END OF SECTION

Edition ----1020

SECTION 21 05 17

SLEEVES & SLEEVE SEALS FOR FIRE SUPPRESSION PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes:
 - 1. Sleeves.
 - 2. Sleeve-seal systems.

1.2 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 A53/A53M, Schedule 40, with plain ends and welded-steel collar; zinc coated.
- C. Galvanized-Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded or snap-lock longitudinal joint.

2.2 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. CALPICO, Inc.
 - 3. Link-Seal by GPT, an EnPro Industries Company.
 - 4. The Metraflex Company.
 - 5. Proco Products, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 1. Sealing Elements: EPDM-rubber or NBR 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 or reinforced nylon polymer.
 - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
 - 1. Sleeves are not required for core-drilled holes through exterior walls or slab-on-grade floors.
- 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 interior of sleeve.
 - 1. For core-drilled holes, size hole large enough to provide 1-inch annular space between piping and concrete wall or slab-on-grade floor.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 - 2. Using grout, seal the space outside of sleeves in slabs and walls.
- D. Install sleeves in core-drilled holes in concrete floors in mechanical equipment areas or other wet areas.
 - 1. Extend sleeves 2 inches above finished floor level.
 - 2. Using grout, seal the space outside of sleeves.
- E. 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 specifications.
- F. 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 specifications.

3.2 SLEEVE-SEAL SYSTEM INSTALLATION

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

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls Above Grade: Cast-iron wall sleeves, galvanized-steel wall sleeves or galvanized-steel pipe sleeves.
2. Exterior Concrete Walls Below Grade:
 - a. Piping Smaller than NPS 4: Cast-iron wall sleeves with sleeve-seal system, galvanized-steel wall sleeves with sleeve-seal system, or galvanized-steel pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 4 and Larger: Cast-iron wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
3. Concrete Slabs-on-Grade:
 - a. Piping Smaller than NPS 4: Cast-iron wall sleeves with sleeve-seal system, galvanized-steel wall sleeves with sleeve-seal system or galvanized-steel pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 4 and Larger: Cast-iron wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
4. Concrete Slabs Above Grade: Galvanized-steel pipe sleeves.
5. Interior Partitions:
 - a. Piping Smaller than NPS 6: Galvanized-steel pipe sleeves.
 - b. Piping NPS 6 and Larger: Galvanized-steel sheet sleeves.

END OF SECTION

Edition 0308-0715

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SECTION 21 05 53

IDENTIFICATION FOR FIRE SUPPRESSION PIPING & EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Valve tags.

1.2 SUBMITTAL

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

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: Black.
 - 3. Background Color: White.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160°F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2" x 3/4".
 - 6. Minimum Letter Size: 1/2 inch. Include secondary lettering 3/8 inch.
 - 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's drawing designation or unique equipment number. Coordinate with the Owner.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Red.
- D. Maximum Temperature: Able to withstand temperatures up to 160°F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2" x 3/4".

- F. Minimum Letter Size: 1/2 inch. Include secondary lettering 3/8 inch.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: As indicated on the drawings or required by the local authority.

2.3 VALVE TAGS

- A. Plastic Labels for Valves:
 - 1. Material and Thickness: Multilayer, multicolor plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: Black.
 - 3. Background Color: White.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160°F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2" x 3/4".
 - 6. Minimum Letter Size: 1/2 inch. Include secondary lettering 3/8 inch.
 - 7. Fasteners: Beaded chain.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean 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 fire suppression system equipment.
- B. Locate equipment labels where accessible and visible.

3.3 VALVE TAG INSTALLATION

- A. Install tags on valves and control devices in fire suppression piping systems.
- B. Valve tags shall include the following information:
 - 1. Piping System: Wet sprinkler riser, pre-action riser, etc.
 - 2. Area Served: First Floor, Data Room, etc.
 - 3. Function: e.g., Inspector's Test, Isolation, etc.

3.4 ADJUSTING AND CLEANING

- A. Relocate fire suppression identification materials and devices that have become visually blocked by other work.

B. Clean faces of fire suppression identification devices.

END OF SECTION

Edition -----0715

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SECTION 21 13 13

WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes:
 - 1. Pipes, fittings, and specialties.
 - 2. Fire-protection valves.
 - 3. Sprinklers.
 - 4. Pressure gauges.

1.2 SYSTEM DESCRIPTIONS

- A. Performance Based Specifications: This section describes requirements necessary to design and install an automatic fire sprinkler system. The licensed Fire Sprinkler Contractor is responsible to design and install the complete fire sprinkler system per NFPA requirements, per the requirements of the Local Authority Having Jurisdiction (AHJ), and per this specification.
- B. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device.

1.3 PERFORMANCE REQUIREMENTS

- A. Design and install a complete automatic wet fire sprinkler system as required by national and local codes that meets the requirements of the AHJ. Systems shall be complete with all components specified for each area protected. The system shall be in accordance with the required edition of the following NFPA Standards:
 - 1. NFPA Chapter 13, Sprinkler Systems, Installation.
 - 2. NFPA Chapter 13R, Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height.
 - 3. NFPA Chapter 25, Inspection, Testing and Maintenance of Water-Based Fire Protection Systems.
 - 4. NFPA Chapter 1963, Fire Hose Connections.
 - 5. NFPA Chapter 14, Standpipe and Hose Systems.
 - 6. NFPA Chapter 15, Water Spray Fixed Systems.
 - 7. NFPA Chapter 24, Private Fire Service Mains.
 - 8. NFPA Chapter 231C, Rack Storage of Materials.
 - 9. Refer to other chapters of the NFPA that are applicable.
- B. Provide field verification of all dimensions. No extra charges or compensation will be allowed for any differences between actual dimensions and measurements indicated.
- C. The Contractor shall pay for or perform flow tests on systems prior to completing fire sprinkler calculations and shop drawings.
- D. Hydraulic design of the system shall be based on a reduction of the measured static pressure by a minimum of 10%, or more if required by the AHJ.

- E. Securing and payment for all necessary permits and inspections.
- F. Design and install the sprinkler system to the sprinkler occupancy hazard classifications as defined in NFPA and per the AHJ.
- G. Minimum Density for Automatic-Sprinkler Piping Design:
 - 1. Residential (Dwelling) Occupancy: 0.05 gpm over 400 square foot area.
 - 2. Light-Hazard Occupancy: 0.10 gpm over 1,500 square foot area.
 - 3. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1,500 square foot area.
 - 4. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1,500 square foot area.
 - 5. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2,500 square foot area.
 - 6. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over 2,500 square foot area.
 - 7. Special Occupancy Hazard: As determined by AHJs.
 - 8. Include hose stream and fire riser flow rates as required.
- H. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Data information is to include pipe material, and manufacturer and model number of all components intended for use on this project.
- B. Shop Drawings: For wet-pipe sprinkler systems. Include detailed plans, elevations, sections, details, and attachments to other work. Shop drawing to also include water calculations. Plans and calculations must be approved by the AHJ before they are submitted to the Engineer for review.
- C. Provide a letter of acceptance from the Owner's fire-protection insurer and complete printed instructions on operation of system to the Owner.
- D. Welding certificates.
- E. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include Contractor's Material and Test Certificate for Aboveground Piping.
- F. Field quality-control reports.
- G. Operation and maintenance data.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Installer's responsibilities include designing, fabricating, and installing sprinkler systems. Base calculations on results of fire-hydrant flow test and criteria stated herein.
 - 1. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer or NICET Designer.
- B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

- C. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Underground Piping: Underground piping shall conform to NFPA Standard 24 (Standard for Installation of Private Fire Mains). All pipe and fittings shall be cleaned of all debris, stone, and dirt and inspected for cracks and holes before being laid. All underground piping shall be thoroughly flushed in accordance with the requirements of NFPA 13 and 24. The test must be witnessed by a proper authority.
- B. Interior Piping: Piping 2 inches and smaller shall be a minimum of Schedule 40 steel pipe. Piping greater than 2 inches shall be a minimum of Schedule 10 steel pipe. All piping shall conform to the requirements in NFPA 13. All other types of pipe or tube are specifically prohibited. All piping shall be treated to prevent microbial-induced corrosion.

2.2 LISTED FIRE-PROTECTION VALVES

A. General Requirements:

- 1. Valves shall be UL listed or FM approved.
- 2. Minimum Pressure Rating: 175 psig.

B. Check Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Clow Valve Company; a Division of McWane, Inc.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Crane Co.; Crane Valve Group; Jenkins Valves.
 - e. Crane Co.; Crane Valve Group; Stockham Division.
 - f. Kennedy Valve; a Division of McWane, Inc.
 - g. Metraflex, Inc.
 - h. Milwaukee Valve Company.
 - i. Mueller Co.; Water Products Division.
 - j. NIBCO INC.
 - k. Potter Roemer.
 - l. Reliable Automatic Sprinkler Co., Inc.
 - m. Shurjoint Piping Products.
 - n. Tyco Fire & Building Products LP.
 - o. United Brass Works, Inc.
 - p. Victaulic Company.
 - q. Viking Corporation.
 - r. Watts Water Technologies, Inc.
- 2. Standard: UL 312.
- 3. Pressure Rating: 250 psig minimum.

4. Type: Swing check.
5. Body Material: Cast or ductile iron.
6. End Connections: Flanged or grooved.

C. Bronze OS&Y Gate Valves:

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. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. United Brass Works, Inc.
2. Standard: UL 262.
3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded.

D. Iron OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. American Valve, Inc.
 - c. Clow Valve Company; a Division of McWane, Inc.
 - d. Crane Co.; Crane Valve Group; Crane Valves.
 - e. Crane Co.; Crane Valve Group; Jenkins Valves.
 - f. Crane Co.; Crane Valve Group; Stockham Division.
 - g. Hammond Valve.
 - h. Milwaukee Valve Company.
 - i. Mueller Co.; Water Products Division.
 - j. NIBCO INC.
 - k. Tyco Fire & Building Products LP.
 - l. United Brass Works, Inc.
 - m. Victaulic Company.
 - n. Watts Water Technologies, Inc.
2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

E. Indicating-Type Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Fivalco Inc.
 - c. Global Safety Products, Inc.
 - d. Kennedy Valve; a Division of McWane, Inc.
 - e. Milwaukee Valve Company.

- f. NIBCO INC.
 - g. Shurjoint Piping Products.
 - h. Tyco Fire & Building Products LP.
 - i. Victaulic Company.
- 2. Standard: UL 1091.
- 3. Pressure Rating: 175 psig minimum.
- 4. Valves NPS 2 and Smaller:
 - a. Valve Type: Ball or butterfly.
 - b. Body Material: Bronze.
 - c. End Connections: Threaded or grooved.
- 5. Valves NPS 2-1/2 and Larger:
 - a. Valve Type: Butterfly.
 - b. Body Material: Cast or ductile iron.
 - c. End Connections: Flanged, grooved, or wafer.
- 6. Valve Operation: Weatherproof housing with integral electrical, 115 VAC, prewired, 2-circuit, supervisory switch indicating device.

2.3 TRIM AND DRAIN VALVES

A. General Requirements:

- 1. Standard: UL's Fire Protection Equipment Directory listing or Approval Guide, published by FM Global listing.
- 2. Minimum Pressure Rating: 175 psig.

B. Ball Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Victaulic Company.
 - f. Watts Water Technologies, Inc.

2.4 SPECIALTY VALVES

A. General Requirements:

- 1. Standard: UL's Fire Protection Equipment Directory listing or Approval Guide, published by FM Global listing.
- 2. Minimum Pressure Rating: 175 psig.
- 3. Body Material: Cast or ductile iron.
- 4. Size: Same as connected piping.
- 5. End Connections: Flanged or grooved.

B. Alarm Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Globe Fire Sprinkler Corporation.
 - c. Reliable Automatic Sprinkler Co., Inc.
 - d. Tyco Fire & Building Products LP.
 - e. Victaulic Company.
 - f. Viking Corporation.
2. Standard: UL 193.
3. Design: For horizontal or vertical installation.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gauges, retarding chamber, and fill-line attachment with strainer.
5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping if retarding chamber is required, or else pipe drain with check valve to main drain piping.

C. Automatic Ball Drip Drain Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire & Building Products LP.
2. Standard: UL 1726.
3. Pressure Rating: 175 psig minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4.
6. End Connections: Threaded.

2.5 SPRINKLERS

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

1. Reliable Automatic Sprinkler Co., Inc.
2. Tyco Fire & Building Products LP.
3. Victaulic Company.
4. Viking Corporation.

B. General Requirements:

1. Standard: UL's Fire Protection Equipment Directory listing or Approval Guide, published by FM Global listing.
2. Pressure Rating for Residential Sprinklers: 175 psig maximum.
3. Pressure Rating for Automatic Sprinklers: 175 psig minimum.
4. Pressure Rating for High-Pressure Automatic Sprinklers: 250 psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Early-Suppression, Fast-Response Applications: UL 1767.

2. Non-Residential Applications: UL 199.
3. Residential Applications: UL 1626.
4. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler finishes, as selected by the Architect:

1. Chrome plated.
2. Bronze.
3. Factory painted or coated.
4. Stainless steel.

E. Sprinkler Escutcheons: Materials, types, and finishes as selected by the Architect for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated, painted, or coated steel, one piece, flat.
2. Sidewall Mounting: Chrome-plated, painted, or coated steel, one piece, flat.

F. Sprinkler Guards:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Reliable Automatic Sprinkler Co., Inc.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

2.6 PRESSURE GAUGES

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

1. AMETEK; U.S. Gauge Division.
2. Ashcroft, Inc.
3. Breco Corporation.
4. WIKA Instrument Corporation.

B. Standard: UL 393.

C. Dial Size: 3-1/2-inch to 4-1/2-inch diameter.

D. Pressure Gauge Range: 0 to 250 psig minimum.

E. Water System Piping Gauge: Include "WATER" or "AIR/WATER" label on dial face.

F. Air System Piping Gauge: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 WATER-SUPPLY CONNECTIONS

- A. Prior to connecting sprinkler piping to interior water distribution piping, verify that flushing of piping has been completed.
- B. Connect sprinkler piping to building's interior water-distribution piping.
- C. Install shutoff valve, check valve, pressure gauge, and drain at connection to water supply.

3.2 PIPING INSTALLATION

- A. Locations and Arrangements: Piping and sprinkler head locations are to be coordinated in the field with other trades and the final ceiling layout.
 - 1. Deviations from approved working plans for piping require written approval from AHJs. File written approval with the Architect before deviating from approved working plans.
- B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- C. Install seismic restraints on piping where required. Comply with requirements for seismic-restraint device materials and installation in NFPA 13.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- G. Install sprinkler piping with drains for complete system drainage.
- H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- I. Install automatic, ball drip, drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to spill-over floor sink or to outside building.
- J. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- K. Install pressure gauges on riser or feed main, at each sprinkler test connection, and at the top of each standpipe. Include pressure gauges with connection not less than NPS 1/4 and with soft metal-seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they will not be subject to freezing.
- L. Fill sprinkler system piping with water.
- M. Install sleeves for piping penetrations of walls, ceilings, and floors.
- N. Install sleeve seals for piping penetrations of concrete walls and slabs.

- O. Install escutcheons for piping penetrations of walls, ceilings, and floors.
- P. Install flexible couplings within 24 inches of building expansion joints.

3.3 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings the same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 - 1. Do not use welded joints for galvanized-steel pipe.
- I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- J. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- K. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and AHJs.

- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves where required in potable-water-supply sources.
- D. Specialty Valves:
 - 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
 - 2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

3.5 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.
- B. Do not install sprinklers that have been dropped, damaged, or show a visible loss of fluid.

3.6 IDENTIFICATION

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

3.7 FIELD QUALITY CONTROL

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

3.8 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.

3.9 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
1. Rooms without Ceilings: Upright sprinklers.
 2. Rooms with Suspended Ceilings: Recessed sprinklers.
 3. Public Rooms with Hard-Lid Ceilings, such as Lobbies, Meeting Rooms, Conference Rooms, etc.: Recessed sprinklers.
 4. Non-Public Rooms with Hard-Lid Ceilings, such as Storage Rooms, Restrooms, Corridors, etc.: Recessed sprinklers.
 5. Wall Mounting: Sidewall sprinklers.
 6. Spaces Subject to Freezing: Pendent or sidewall dry sprinklers.
 7. Special Applications: Extended-coverage and quick-response sprinklers where indicated.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
 2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
 3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
 4. Residential Sprinklers: Dull chrome.
 5. Upright, Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION

Edition 0308-1216

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DIVISION 22

PLUMBING

22 05 00	Common Work Results for Plumbing
22 05 00	General Provisions
22 05 13	Common Motor Requirements for Plumbing Equipment
22 05 17	Sleeves & Sleeve Seals for Plumbing Piping
22 05 18	Escutcheons for Plumbing Piping
22 05 19	Meters & Gages for Plumbing Piping
22 05 23	General Duty Valves for Plumbing Water Piping
22 05 29	Hangers & Supports for Plumbing Piping & Equipment
22 05 53	Identification for Plumbing Piping & Equipment
22 07 00	Plumbing Insulation
22 07 19	Plumbing Piping Insulation
22 11 00	Facility Water Distribution
22 11 16	Domestic Water Piping
22 11 19	Domestic Water Piping Specialties
22 11 23	Domestic Hot Water Recirculating Pumps
22 13 00	Facility Sanitary Sewerage
22 13 16	Sanitary Waste & Vent Piping
22 13 19	Sanitary Waste Piping Specialties
22 33 00	Electric Domestic Water Heaters
22 33 00	Electric Domestic Water Heaters
22 40 00	Plumbing Fixtures
22 40 00	Plumbing Fixtures
22 47 00	Drinking Fountains & Water Coolers
22 47 00	Drinking Fountains & Water Coolers

END OF INDEX



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SECTION 22 05 00
GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SCOPE

- A. Provisions of this section apply to all work specified in all sections under Division 22.
- B. In addition, work in Division 22 is governed by the provisions of the Bidding Requirements, Contract Forms, General Conditions, and all sections in Division 01, General Requirements.
- C. The Contract Documents do not specify exact installation means and methods or Contractor safety procedures. Installation means and methods and safety procedures are the responsibility of the Contractor. No instruction or statement made on the Contract Documents shall be interpreted to shift this responsibility away from the Contractor.
- D. These specifications contain statements which are more definitive or more restrictive than those contained in the General Conditions. Where these statements occur, they shall take precedence over the General Conditions.

1.2 DEFINITIONS

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

1.3 EXAMINATION OF PREMISES

- A. Visit the site, verify all measurements and project conditions, and pay all costs necessary to perform the work.

1.4 PLUMBING CONTRACTOR

- A. The Plumbing Contractor shall hold a current contracting license that has been valid for a minimum of 2 years in the State of Arizona as a plumbing contractor.

1.5 REGULATIONS, PERMITS, FEES, CHARGES, INSPECTIONS

- A. Regulations: Comply with all applicable codes, rules and regulations.
- B. Fees and Permits: Pay all connection, installation, use, disposal, development, etc., fees and/or charges. Obtain and pay for all required permits and licenses. Refer to Division 01 specifications.
- C. Inspections: All work must be inspected and approved by local authorities. Prior to final approval, furnish the Architect with certificates of inspections and approvals by the local authorities in accordance with Division 01 specifications.

1.6 DRAWINGS AND SPECIFICATIONS

- A. Refer to Division 01 specifications for additional information on submittals and shop drawings.
- B. If a conflict exists on the drawings or between the drawings and specifications, promptly notify the Architect.

1.7 SUBMITTALS

- A. Submittals are for information and coordination only. The Engineer will diligently review the submittals and attempt to verify compliance with the project requirements. Such review, however, does not constitute approval or disapproval or obligation to comply with all project requirements. The submittals are not to be construed to be Contract Documents. Any failure by the Engineer to note a point of non-compliance shall not be construed to be acceptance or approval of the discrepancy.
- B. Product Information Sheets: Provide project specific manufacturer's literature which includes the information required by the Product Data paragraph of the applicable specification section. Where product information sheets show multiple models or options, clearly mark the model and options to be provided.
- C. Assembly: Assemble all required submittal information for each specification section and submit in PDF format.
 - 1. Assemble PDF submittals in one PDF file for each division. Separate and order sections within each file by corresponding specification number. Provide bookmarks at the first page of each section and label each bookmark with the specification number and name to allow for easy navigation of the submittal.
 - 2. Partial submittals and submittals that are not project specific will be returned without review.
- D. Identification and Information:
 - 1. Name the PDF file with the project name, division number and sequential submittal number (i.e., the first submittal shall be No. 1; the second submittal shall be No. 2).
 - 2. Provide a cover sheet at the front of each submittal with the following information:
 - a. Project name.
 - b. Date.
 - c. Name of Engineer.
 - d. Name of Contractor.
 - e. Name of subcontractor.

3. Provide a cover sheet at the front of each submittal section with the following information:

- a. Name of supplier.
- b. Name of manufacturer.
- c. Number and title of appropriate specification section.
- d. Drawing number and detail references, as appropriate.
- e. Other necessary identification.

E. Options:

1. Identify options requiring selection by the Engineer.
2. Identify options included with submittal item.

F. Deviations: Identify deviations from the Contract Documents on submittals.

G. Furnished by Others: This project is to provide a complete and functional system. Where material or labor is indicated in the submittal to be provided "by others" clearly indicate who is providing those items and include information to indicate proper coordination.

1.8 MATERIAL SAFETY DATA SHEETS

A. Provide current Material Safety Data Sheets (MSDS) for all hazardous materials that are proposed for use at the project site.

1. Provide one complete set to the Owner for review and approval a minimum of 1 week prior to the delivery of any hazardous materials to the site.
2. Maintain a second complete set at the project location, readily accessible by both the Owner's personnel and the Contractor's personnel.

1.9 REQUEST FOR INFORMATION

A. Request for Information (RFI):

1. A document submitted by the Contractor requesting clarification of a portion of the Contract Documents, hereinafter referred to as an RFI.
2. A properly prepared request for information shall include a detailed written statement of the clarification, apparent conflict, or information requested that indicates the specific drawings or specification in need of clarification and the nature of the clarification requested.
 - a. Drawings shall be identified by drawing number and location on the drawing sheet.
 - b. Specifications shall be identified by section number, page, and paragraph.
3. Include a proposed solution, where appropriate, based upon the field conditions and best knowledge of the Contractor.

B. Improper or Frivolous RFIs: RFIs which are not properly prepared or that request information which is clearly shown in the Contract Documents will be returned unanswered. Processing time for multiple submissions of improper or frivolous RFIs will be billed at the Engineer's standard hourly rate to the Owner who may deduct an equal amount from the monies due the Contractor.

1.10 AS-BUILT DRAWINGS

A. As-Built Drawings: Maintain one set of marked-up paper copies of the Contract Drawings.

1. Preparation: Mark As-Built Drawings to show the actual installation where installation varies from that shown originally. Include all equipment, and underground and overhead piping.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Include dimensions both horizontally and vertically to permanent points of reference, accurate within 6 inches. Include descriptors such as "below slab," "above ceiling," etc.
 - c. Record data daily or as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 2. Mark the As-Built Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of As-Built Drawings.
 3. Mark the As-Built Drawings with erasable, red colored pencil, or in a digital PDF format using an editor program such as Bluebeam, Adobe Acrobat Professional, or similar. Use other colors to distinguish between changes for different categories of the work at the same location.
 4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
 5. Update the As-Built Drawings weekly or daily as appropriate for the project size.
- B. Format: Identify and date each As-Built Drawing; include the designation "PROJECT AS-BUILT DRAWING" in a prominent location.
1. Organize newly-prepared As-Built Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Identification, as follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT AS-BUILT DRAWINGS."
 - d. Name of Engineer.
 - e. Name of Contractor.
 3. Remove or obscure the Engineer's seal and signature from As-Built Drawings.

1.11 OPERATION AND MAINTENANCE MANUAL

- A. Prior to completion of the project, compile a complete equipment, operation and maintenance manual for all equipment supplied under Division 22.
- B. Schedule:
1. Submit a preliminary copy of the manual not less than 30 days prior to Substantial Completion for review and comment.
 2. Submit the final version the manual not more than 4 weeks after Substantial Completion of the project.
- C. Format: Submit manuals in both of the following formats:
1. PDF Electronic Files: Assemble each manual into a single master directory with subdirectories for the individual PDF files for each system and piece of equipment. Provide a table of contents file with hyperlinks to each of the individual PDF files within the subdirectories. Submit on digital media acceptable to Engineer.

- a. Name each directory, subdirectory, and document file with applicable item name.
 - b. Enable reviewer comments on draft submittals.
2. Paper Copies: Assemble paper copies in 3-ring binders. Separate and order systems and equipment within each binder. Provide labeled tabs at each section with a table of contents at the front of the binder. The table of contents shall indicate the tab number and the information contained at that tab. Enclose title pages and directories in clear plastic sleeves.
- D. Provide operating and maintenance manuals for all systems, subsystems, and equipment that require operation and regular maintenance, or have replaceable parts.
- E. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, product data, manufacturer's 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. In addition to requirements in this section, include operation and maintenance data required in individual specification sections.
- F. 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.
- G. Product Data: Include the following information:
 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Approved submittals.
 3. Include the following if not shown on approved submittals:
 - a. Product name and model number. Use designations for products indicated on Contract Documents.
 - b. Manufacturer's name.
 - c. Equipment identification with serial number of each component.
 - d. Equipment function.
 - e. Operating characteristics.
 - f. Limiting conditions.
 - g. Performance curves.
 - h. Engineering data and tests.
- H. Operating Procedures: Include the following, as applicable:
 1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures. Including precautions against improper use.
 10. Operating logs.

- I. Wiring Diagrams: Diagram of factory-installed wiring including any options as well as any field modifications.
 - J. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
 - K. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification. Include valve locations and designations.
 - L. Manufacturer's Maintenance Documentation: Provide manufacturer's 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.
 - M. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.
 - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - 5. Aligning, adjusting, and checking instructions.
 - 6. Demonstration and training video recording, if available.
 - N. 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.
 - O. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturer's maintenance documentation and local sources of maintenance materials and related services.
 - P. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
 - Q. Licenses: Include copies of any licenses with requirements including inspection and renewal dates.
 - R. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
- 1.12 WORK AND MATERIALS
- A. Unless otherwise specified, all materials must be new and of the quality specified. The workmanship shall be of a quality that is acceptable to the Architect, Engineer, and Owner, and is equal to the standards of the trades. Contractor must staff the project with sufficient skilled workmen, including a fully qualified construction superintendent, to complete the work in the time allotted. The superintendent must be qualified to supervise all of the work in his work category.
 - B. Uniformity: Unless otherwise specified, provide all equipment and products of same type or classification by the same manufacturer.

1.13 APPROVALS OF MATERIALS AND EQUIPMENT

- A. Refer to Division 01 specifications for description of material and equipment for prior approvals and substitutions.

1.14 COOPERATIVE WORK

- A. Correct without charge any work requiring alteration due to lack of proper supervision or failure to make proper provision in time. Correct without charge any damage to adjacent work caused by the alteration. Refer to Division 01 specifications for additional requirements.
- B. Cooperative Work Includes:
 - 1. General supervision and responsibility for proper location, rough-in and size of work related to Division 22 but provided under other divisions of these specifications.
 - 2. Installation of sleeves, inserts and anchors bolts for work under sections in Division 22.

1.15 EXISTING MATERIALS AND EQUIPMENT

- A. Disposition: With the exception of items that are to be reused or retained by the Owner, all other materials indicated to be removed shall be removed and legally disposed of by the Contractor. Items that are indicated to be retained or returned to the Owner shall be delivered to a storage area designated by the Owner.
- B. Unused Materials: All unused piping, controls and miscellaneous materials shall be removed by the Contractor except where located within walls, below or above existing construction which is not being altered and would require removal and replacement of this existing construction. All visible piping, etc., shall be removed and sealed or capped within wall, below floor, or above ceiling unless noted otherwise.
- C. Exterior Services: The Contractor shall be responsible for maintaining plumbing services to the existing building during the construction period. Existing services are to be retained until such a time that the new services, if any, are completely installed and ready for use. Scheduling of service interruptions is to be coordinated with the Architect and Owner.
- D. Disconnect, demolish, and remove plumbing systems, equipment, and components that are indicated to be removed.
 - 1. Piping to be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material. Patch insulation, as required, to match adjacent areas.
 - 2. Piping to be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Equipment and Fixtures to be Removed: Disconnect and cap services and remove equipment and fixtures.
 - 4. Equipment and Fixtures to be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment and fixtures; when appropriate, reinstall, reconnect, and make equipment fixtures operational.
 - 5. Equipment and Fixtures to be Removed and Salvaged: Disconnect and cap services and remove equipment and fixtures, and deliver to Owner.
- E. Continuity of Services in Existing Building: Contractor shall permanently reroute existing plumbing services or provide temporary connection as required to maintain service to existing fixtures, equipment, and systems in building which are to remain in service.

- F. Rerouting and Relocation of Existing Plumbing Equipment and Services in Existing Building:
 - 1. General: Contractor shall reroute, relocate all existing materials which are in conflict with the building alterations and which are required to be maintained in use.
 - 2. Existing Piping: Where applicable, existing material may be reused in their original location unless otherwise indicated.
- G. Testing: All existing services affected by the new construction and which are modified, reused or are to remain in operation shall be returned to their original condition. The existing services shall be tested as new, as described in other sections of these specifications. If for any reason these requirements cannot be met, the Contractor shall immediately notify the Architect.

1.16 CONSTRUCTION FACILITIES

- A. General: Under this division of the specifications, execute all work in a manner to provide safe and lawful ingress and egress to the Owner's establishment and such facilities shall be kept clear of materials or equipment. Refer to Division 01 specifications for additional requirements.
- B. Furnish and maintain from the beginning to the completion of all work all lawful and necessary security, guards, railings, fences, canopies, lights, fire protection, and warning signs. Take all necessary precautions required by city and state laws to avoid injury or damage to any and all persons and property.

1.17 GUARANTEE

- A. Guarantee all material, equipment, installation and workmanship for all sections under Division 22 in writing to be free from defects of material and workmanship for 1 year from date of final acceptance as outlined in Division 01 specifications. Equipment warranties shall be a minimum of 1 year from date of Substantial Completion or as specified elsewhere. Replace without charge any material or equipment proving defective during this period. The guarantee shall include performance of the equipment under all conditions.

1.18 ELECTRICAL WORK

- A. Electrical wiring, including power wiring and control wiring, except as otherwise specified under Division 22, all raceways, outlet and junction boxes, and labor for installation of the wiring and equipment shall be included in Division 26 of the specifications.
- B. All loose starters and control devices for equipment furnished under Division 22, except as otherwise specified under Division 22, are to be furnished under that particular section of Division 22 and installed under Division 26.
- C. Contractor shall be responsible for the checking and testing of all controls and the interlocks for a complete and satisfactory operating system.
- D. Before ordering any motors and equipment, verify the available voltage and phase for all motors with the Division 26 Contractor.
- E. Submit a complete list of all motors prior to final closeout of project indicating the location, horsepower, voltage, phase, and amperage draw of each motor.
- F. All field wiring and equipment must conform to the applicable Division 26 specification sections.

PART 2 - PRODUCTS

2.1 EQUIPMENT DESIGN AND INSTALLATION

- A. Design: Design all equipment in accordance with latest edition of ASME, AGA, UL, and other applicable technical standards as follows:
 - 1. Pressure Vessels: ASME Code constructed and stamped.
 - 2. Electric Appliances: UL labeled.

2.2 GROUT

- A. Description: ASTM C1107, Grade B, non-shrink and non-metallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, non-staining, non-corrosive, non-gaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5,000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SUBMITTALS

- A. Prepare submittals as directed for review by the Contractor, Owner, Architect, and Engineer.
- B. Submit one copy of PDF submittals via email, project website or other electronic media.

3.2 AS-BUILT DRAWINGS AND RECORD DOCUMENTS

- A. Recording: Post changes and modifications to the As-Built Drawings as they occur; do not wait until the end of the project.
- B. Maintenance of As-Built Drawings and Record Documents: Store Record Documents in the field office, apart from the Contract Documents used for construction. Do not use project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project Record Documents for the Engineer's reference during normal working hours. As-Built Drawings will be reviewed by the Architect, Owner, and Engineer at each pay request review.
- C. Submit As-Built Drawings to the Architect at completion of the project.

3.3 OPERATION AND MAINTENANCE MANUALS

- A. Prepare operation and maintenance manuals as directed.
- B. Submit a preliminary electronic copy of the operation and maintenance manual to the Engineer for review.
- C. Make any corrections noted from the Engineer's review upon receipt of comments and resubmit as required.
- D. Submit the final, corrected operation and maintenance manual in both paper and electronic format to the Architect.

3.4 VERIFICATION OF DIMENSIONS

- A. Scaled and figured dimensions are approximate only. Before proceeding with work, carefully check and verify dimensions at site, and be responsible for properly fitting equipment and materials together and to the structure in spaces provided.
- B. Drawings are essentially diagrammatic and many offsets, bends, special fittings and exact locations are not indicated. Carefully study drawings and premises in order to determine best sequence and installation methods, exact locations, routes, building obstructions, and install apparatus and equipment in available locations. Install apparatus and equipment in manner and in locations to avoid obstructions, preserve headroom, and keep openings and passageways clear.

3.5 CUTTING AND PATCHING

- A. Cut work and patch per Division 01 specifications as necessary to properly install the new work. As the work progresses, coordinate necessary openings, holes, chases, etc., in their correct location. If the required openings, holes and chases are not in their correct locations, make the necessary corrections at no cost to the Owner. Avoid excessive cutting and do not cut structural members without the consent of the Architect. Include as a part of the work all structural framing required by penetrations through the roof and necessary design and installation of steel to support equipment and pipes between structural steel unless shown on the structural drawings.

3.6 CLOSING-IN OF UNFINISHED WORK

- A. Cover no work until inspected, tested and approved. Where work is covered before inspection and test, uncover it, and when inspected, tested and approved, restore all work to original proper condition.

3.7 EXCAVATION AND BACKFILL

- A. Perform all necessary excavation, shoring and backfilling required for the proper laying of all pipes inside the building and premises, and outside as may be necessary. Remove all excess excavated materials from the site or dispose of on site as directed by General Contractor.
- B. Excavate all trenches open cut, keep trench banks as nearly vertical as practicable, and sheet and brace trenches where required for stability and safety. Excavate trenches true to line and make bottoms not less than 18 inches wide but no wider than necessary to provide ample work room. Excavate to provide continuous granular bedding as indicated. Do not cut any trench near or under footings without first consulting the Architect. Comply with OSHA requirements.
- C. Provide not less than 4 inches of granular material as pipe bedding. Grade and compact trench bedding accurately prior to laying pipe in trench to provide uniform bearing and support for each section of pipe along its entire length. Dig "bell" holes after the trench bottom has been graded and compacted. Granular material shall be pea gravel or sand per MAG Standards.
- D. Provide backfilling and compaction in accordance with provisions of these specifications and under the direction of the Architect to the required density.
- E. Provide not less than 4 inches of granular material, same as piping bedding, all around pipe. Make the first 2 feet of fill in 6-inch layers, each thoroughly compacted as directed with no puddling, and free from rocks, large clods of earth, leaves, branches, and debris. Compact the rest of the backfill as directed, using in the backfill no rocks larger than 4 inches in diameter, and using no rock in the top 12 inches.

3.8 ACCESSIBILITY

- A. Install valves, thermometers, gauges, traps, cleanouts, control devices or other specialties requiring reading, adjustment, inspection, repairs, removal or replacement conveniently and accessibly throughout the finished building. Where any of these devices are shown on the Contract Drawings to be installed above any inaccessible ceiling or behind any inaccessible wall, the Plumbing Contractor shall furnish access doors or panels as required.
- B. All access doors or panels in walls and ceilings required for access to control devices, traps, valves and similar devices are to be furnished and installed as part of the work under this section. Provide type as specified in Division 08 specifications.
- C. Refer to architectural drawings for type of wall and ceiling in each area and for rated construction.
- D. Coordinate work of various sections to locate valves, traps, etc., with others to avoid unnecessary duplication of access doors.
- E. The Contractor, along with the Owner's representative, shall complete the Plumbing Accessibility/Clearance Checklist at the end of this section for all plumbing equipment. The chart shall be submitted to the Architect for approval prior to Substantial Completion. All conflicts shall be resolved to the Architect's and Owner's satisfaction prior to submission.

3.9 FLASHINGS

- A. Flash and counterflash all piping penetrating roofing membrane with flashing per roofing manufacturer's recommendations. Refer to architectural drawings for detailing of pipe penetrations through roof.
- B. Flash and counterflash all piping penetrating exterior walls. Refer to architectural drawings for detailing of pipe penetrations through walls.

3.10 PRODUCT AND EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. All equipment, valves, sensors, etc., shall be installed in strict conformance with the manufacturer's recommendations and all codes.
- B. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.
- C. Install equipment and piping level and plumb, parallel and perpendicular to other building systems and components, unless otherwise indicated.
- D. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations.
- E. Install equipment and piping to allow right-of-way for piping installed at required slope.
- F. Do not install any equipment in an application not recommended by the manufacturer.

3.11 EQUIPMENT ROUGH-IN

- A. Rough in all equipment and fixtures as designated on the approved submittals and in the Construction Documents. The Contract Drawings indicate only the approximate location of rough-ins. The exact rough-in locations must be determined from large-scale certified drawings. The Contractor shall obtain all certified rough-in information before progressing with any work for rough-in.
- B. Be responsible for providing all outlets and services of proper size at the required locations.
- C. Minor changes in the Contract Drawings shall be anticipated and provided for under this contract.
 - 1. Rough-in only (unless otherwise designated on the drawings) shall include providing all services as indicated and required, including all piping, valves, and fittings. Valve and cap all piping stub-outs.

3.12 OWNER-FURNISHED AND OTHER EQUIPMENT

- A. Rough-in only for all Owner-furnished equipment refer to Division 01 specifications and all equipment furnished under other sections of the specifications, except as otherwise specified and/or noted on the drawings.
- B. Obtain rough-in drawings from the Owner or other contractors prior to roughing-in any services.
- C. Provide all services required. Valve and cap all piping, and leave in a clean and orderly manner.

3.13 EQUIPMENT FINAL CONNECTIONS

- A. Provide all piping final connections for all equipment under Division 22 and as indicated on the drawings.

3.14 EQUIPMENT SUPPORTS

- A. Erection of Metal Supports and Anchorages:
 - 1. Refer to Division 05 specifications for structural steel.
 - 2. Design, cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment. Neatly fabricate and erect steel work with burrs and welding spatter ground off. Paint after fabrication with a rust-inhibitive primer.
 - 3. Field Welding: Comply with AWS D1.1.
- B. Erection of Wood Supports and Anchorages:
 - 1. Design, cut, fit, and place wood grounds, nailers, blocking, and anchorages to support and anchor plumbing materials and equipment.
 - 2. 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.
 - 3. Attach to substrates as required to support applied loads.

- C. Where supports, foundations, stands, suspended platforms for machinery, tanks, or other equipment are indicated or specified, perform the following:
1. Locate support members to avoid equipment strains and interference with piping connections and maintenance operations.
 2. Where saddles are required, use cast-iron or welded-steel saddles with curvature to fit the tank shell.
 3. Mount power-driven equipment on common base with driver.
- D. Concrete Inserts: Furnish and install all concrete inserts required for all materials and equipment specified and/or shown on the drawings for Division 22.
- E. Concrete Housekeeping Pads and Isolation Bases: Work under this section includes coordination of construction of all concrete foundations indicated or required for equipment specified under Division 22. Materials and workmanship shall be described in Division 03 specifications. Anchor equipment to concrete housekeeping pads and isolation bases according to equipment manufacturer's written instructions and according to seismic codes at project.
1. Construct concrete housekeeping pads and isolation bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 2. Install dowel rods to connect concrete pads to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the pad.
 3. Install epoxy-coated anchor bolts for supported equipment that extends through concrete pad, 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.
- F. Grouting:
1. Grout under all equipment after leveling, filling completely the space between machinery base plate and foundation surface as specified in Division 03 specifications.
 2. Mix and install grout for plumbing equipment base bearing surfaces, pumps and other equipment base plates, and anchors.
 3. Clean surfaces that will come into contact with grout.
 4. Provide forms as required for placement of grout.
 5. Avoid air entrapment during placement of grout.
 6. Place grout, completely filling equipment bases.
 7. Place grout on concrete pads and isolation bases and provide smooth bearing surface for equipment.
 8. Place grout around anchors.
 9. Cure placed grout.
 10. Finish exposed surface of grout for a neat appearance.

3.15 CLEANUP

- A. In addition to cleanup specified in Division 01 specifications, thoroughly clean all parts of the equipment and fixtures. Where exposed parts are to be painted, thoroughly clean off any splattered construction materials and remove all oil and grease spots. Wipe the surface carefully and scrape out all cracks and corners.
- B. Thoroughly flush and clean all water systems.

- C. During the progress of the work, keep the premises clean and free of debris.

3.16 PAINTING

- A. Except as otherwise specified or indicated in the architectural drawings and/or specifications, paint all exposed unfinished metal with one coat of rust-inhibiting primer. Stainless-steel, aluminum, galvanized, and factory-painted equipment shall be considered as having primed surface.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- C. Finished painting is specified in Division 09 specifications.

3.17 FIRESTOPPING

- A. Coordinate with the firestopping installer for sealing of all penetrations of fire and smoke barriers and other rated assemblies created during the installation of the Division 22 work.

3.18 CONNECTIONS TO SERVICES

- A. Provide all connections to sanitary sewer lines, storm water lines, gas lines, and water lines, except as otherwise specifically designated. Provide all necessary tees, taps and connections required to properly connect to all building services. Verify all requirements with civil drawings before making any piping connections to sanitary sewer, storm sewer, water or gas piping and conform to them during installation.

3.19 OBJECTIONABLE NOISE AND VIBRATION

- A. Construct and brace piping systems to prevent vibration or rattling when systems are in operation. Install connections to equipment so noise and vibration will not reach the conditioned area through piping, conduit, or the building structure.

3.20 WELDING

- A. Procedures:
 - 1. All procedures and welders must be qualified in accordance with the requirements of Section IX, ASME Boiler and Pressure Vessel Code and ANSI code for power piping B31.1. Procedure qualification test records and acceptance shall be submitted with the welding procedure prior to the start of fabrication.
 - 2. Architect's inspector or authorized representative will review performance qualification records of individual welders.

END OF SECTION

Edition ----1219

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SECTION 22 05 13

COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes general requirements for single-phase and polyphase, general-purpose, horizontal and vertical, small and medium, squirrel-cage induction motors for use on AC power systems up to 600V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this section except when stricter requirements are specified in plumbing equipment schedules or sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 104°F and at altitude of 3,300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multi-Speed Motors: Variable-torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.

- 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Rotor: Random-wound, squirrel-cage.
- F. Bearings: Regreasable, shielded, anti-friction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating.
- H. Insulation: Class F.
- I. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multi-Speed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers:
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
 - 5. Bearing Protection Device: Field- or factory-applied shaft grounding ring consisting of metal ring supporting carbon microfibers to provide grounding path between shaft and motor casing.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 HP shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
 - 5. Electronically commutated.
- B. Multi-Speed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, anti-friction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.

- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

2.6 ELECTRONICALLY COMMUTATED MOTOR

- A. Description: Motor with integral electronics to convert incoming AC power to DC power along with controls to vary the speed of the motor based on an internal or external signal.
- B. Controls: Provide with internal controls and programming or external inputs, depending on the application, to allow for motor speed control.
- C. Motor Protection: Provide with integral safeties to limit motor speed or de-energize motor if operating in an over-temperature or overloaded condition.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

Edition 0605-1015

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SECTION 22 05 17

SLEEVES & SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes:
 - 1. Sleeves.
 - 2. Sleeve seal systems.

1.2 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 A53/A53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded or snap-lock longitudinal joint.

2.2 SLEEVE SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. CALPICO, Inc.
 - 3. Link-Seal by GPT, an EnPro Industries Company.
 - 4. The Metraflex Company.
 - 5. Proco Products, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 1. Sealing Elements: EPDM-rubber or NBR 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 or reinforced nylon polymer.
 - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
 - 1. Sleeves are not required for core-drilled holes through exterior walls or slab-on-grade floors.
- 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 interior of sleeve.
 - 1. For core-drilled holes, size hole large enough to provide 1-inch annular space between piping and concrete wall or slab-on-grade floor.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 - 2. Using grout, seal the space outside of sleeves in slabs and walls.
- D. Install sleeves in core-drilled holes in concrete floors in mechanical equipment areas or other wet areas.
 - 1. Extend sleeves 2 inches above finished floor level.
 - 2. Using grout, seal the space outside of sleeves.
- E. 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 specifications.
- F. 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 specifications.

3.2 SLEEVE SEAL SYSTEM INSTALLATION

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

3.3 SLEEVE AND SLEEVE SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls Above Grade: Cast-iron wall sleeves, galvanized-steel wall sleeves or galvanized-steel-pipe sleeves.
2. Exterior Concrete Walls Below Grade:
 - a. Piping Smaller than NPS 4: Cast-iron wall sleeves with sleeve seal system, galvanized-steel wall sleeves with sleeve seal system or galvanized-steel-pipe sleeves with sleeve seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve seal system.
 - b. Piping NPS 4 and Larger: Cast-iron wall sleeves with sleeve seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve seal system.
3. Concrete Foundation or Stem Walls Below Grade:
 - a. Piping Smaller than NPS 4: Cast-iron wall sleeves.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve.
 - b. Piping NPS 4 and Larger: Cast-iron wall sleeves.
4. Concrete Slabs-on-Grade:
 - a. Piping Smaller than NPS 4: Cast-iron wall sleeves with sleeve seal system, galvanized-steel wall sleeves with sleeve seal system or galvanized-steel-pipe sleeves with sleeve seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve seal system.
 - b. Piping NPS 4 and Larger: Cast-iron wall sleeves with sleeve seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve seal system.
5. Concrete Slabs Above Grade: Galvanized-steel-pipe sleeves.
6. Interior Partitions:
 - a. Piping Smaller than NPS 6: Galvanized-steel-pipe sleeves.
 - b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION

Edition 0308-0416

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SECTION 22 05 18

ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.2 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.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw and polished chrome-plated finish.

2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- B. Split-Casting, Floor Plate Type: Cast brass with concealed hinge and set screw.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Insulated Piping: One-piece, stamped-steel type.
 - c. Bare Piping: One-piece, cast-brass type.

- 2. Escutcheons for existing piping shall be split-casting, cast-brass type.
 - C. Install floor plates for piping penetrations of equipment-room floors.
 - D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. New Piping: One-piece, floor-plate type.
 - 2. Existing Piping: Split-casting, floor-plate type.
- 3.2 FIELD QUALITY CONTROL
- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

Edition 0308-1009

SECTION 22 05 19

METERS & GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes:
 - 1. Liquid-in-glass thermometers.
 - 2. Thermowells.
 - 3. Dial-type pressure gages.
 - 4. Gage attachments.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product certificates.
- C. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 LIQUID-IN-GLASS THERMOMETER

- A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Miljoco Corporation.
 - b. Palmer Wahl Instrumentation Group.
 - c. Terice, H.O. Co.
 - d. Weiss Instruments, Inc.
 - e. Winters Instruments – U.S.
 - 2. Standard: ASME B40.200.
 - 3. Case: Cast aluminum, 9-inch nominal size unless otherwise indicated.
 - 4. Case Form: Adjustable angle unless otherwise indicated.
 - 5. Tube: Glass with magnifying lens and blue or red organic liquid.
 - 6. Tube Background: Non-reflective aluminum with permanently etched scale markings graduated in degrees F.
 - 7. Window: Glass.
 - 8. Stem: Bare aluminum and of length to suit installation.
 - 9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
 - 10. Accuracy: $\pm 1\%$ of scale range or one scale division, to a maximum of 1.5% of scale range.

2.2 THERMOWELLS

- A. Standard: ASME B40.200.

- B. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
- C. Material for Use with Copper Tubing: Brass.
- D. Material for Use with Steel Piping: Stainless Steel.
- E. Type: Stepped shank unless straight or tapered shank is indicated.
- F. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
- G. Internal Threads: 1-1/4 inch, with ASME B1.1 screw threads.
- H. Bore: Diameter required to match thermometer bulb or stem.
- I. Insertion Length: Length required to match thermometer bulb or stem.
- J. Lagging Extension: Include on thermowells for insulated piping and tubing.
- K. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

2.3 PRESSURE GAGES

A. Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Marsh Bellofram.
 - b. Miljoco Corporation.
 - c. Palmer Wahl Instrumentation Group.
 - d. Terice, H. O. Co.
 - e. Weiss Instruments, Inc.
 - f. Weksler.
2. Standard: ASME B40.100.
3. Case: Liquid-filled sealed type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Non-reflective aluminum with permanently-etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Metal.
11. Accuracy: Grade A, $\pm 1\%$ of middle half of scale range.

2.4 GAGE ATTACHMENTS

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

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer and temperature sensor connectors. Include bushings if required to match sizes.
- C. Install thermowells as directed by the Building Automation System Contractor.
- D. Install thermowells with extension on insulated piping.
- E. Fill thermowells with heat-transfer medium.
- F. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- H. Install valve and snubber in piping for each pressure gage for fluids.
- I. Install thermometers where indicated on the drawings and in the following locations:
 - 1. Outlet of each water heater.
 - 2. Two inlets and one outlet of each mixing valve.
 - 3. Inlet and outlet of each thermal-storage tank.
- J. Install pressure gages where indicated on the drawings and in the following locations:
 - 1. Discharge of each pressure-reducing valve.
 - 2. Each pump. Provide one gage per pump with tubing and valves to allow measurement at strainer inlet, pump inlet, and pump discharge.

3.2 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Cold- and Hot-Water Piping: 0 to 250°F.

3.5 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range: 0 to 100 psi.

END OF SECTION

Edition 0607-1015

SECTION 22 05 23

GENERAL DUTY VALVES FOR PLUMBING WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes:
 - 1. Ball valves.
 - 2. Bronze swing check valves.
 - 3. Iron swing check valves.

1.2 SUBMITTALS

- A. Product Data: For each type of valve indicated.
- B. Warranty information.
- C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
- B. NSF Compliance: NSF 61-G for valve materials for potable-water service.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to Plumbing 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: The same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 6 and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Handlever: For quarter-turn valves NPS 4 and smaller except plug valves.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Ball Valves in Chilled Drinking Water Service: 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. Assembly shall be UL 2043 Classified.

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.
3. Threaded: With threads according to ASME B1.20.1.

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

1. American Valve.
2. Conbraco Industries, Inc.; Apollo Valves.
3. FNW.
4. Hammond Valve.
5. Kitz Corporation of America.
6. Milwaukee Valve Company.
7. NIBCO INC.
8. Watts Regulator Co.; a Division of Watts Water Technologies, Inc.

2.2 BALL VALVES

A. Two-Piece, Full-Port Ball Valves with Bronze Trim:

1. Standard: MSS SP-110.
2. Compliance: ANSI/NSF 372 lead-free.
3. SWP Rating: 150 psig.
4. CWP Rating: 600 psig.
5. Body Design: Two piece.
6. Body Material:
 - a. Valves 2 Inches and Smaller: Forged bronze.
 - b. Valves 2-1/2 Inches and Larger: Forged bronze or brass.
7. Ends: Soldered or threaded as indicated below.
8. Seats: PTFE or TFE.
9. Stem: Bronze or brass to match valve body.
10. Ball: Chrome-plated brass.
11. Port: Full.

B. Two-Piece, Full-Port Cast-Iron Ball Valves:

1. Standard: ANSI B16.10.
2. Compliance:
 - a. ANSI/NSF 61-8 drinking water safe.
 - b. ANSI/NSF 372 lead-free.
3. SWP Rating: 125 psig.
4. CWP Rating: 200 psig.
5. Body Design: Two piece.
6. Body Material: Epoxy-coated cast iron.
7. Ends: Flanged.
8. Seats: PTFE or TFE.
9. Stem: Stainless steel, blowout proof design.
10. Ball: Teflon fused cast iron or stainless steel.
11. Port: Full.

PART 3 - EXECUTION

3.1 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 and handle movement.
- E. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.

3.2 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.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not otherwise indicated, use the following:
 - 1. Shutoff Service: Ball or gate valves.
 - 2. Throttling Service: Ball valves.
 - 3. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
 - b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- C. Select valves with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 4 and Smaller:
 - 1. Brass and Bronze Valves: NPS 2-1/2 and smaller may be provided with solder-joint ends instead of threaded ends. NPS 3 and larger threaded or flanged ends.
 - 2. Ball Valves: Two piece, full port.

3. Bronze Swing Check Valves: Class 125, bronze disc.

END OF SECTION

Edition 0905-0517

SECTION 22 05 29

HANGERS & SUPPORTS FOR PLUMBING PIPING & EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes:
 - 1. Metal pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Thermal-hanger shield inserts.
 - 4. Fastener systems.
 - 5. Pipe positioning systems.
 - 6. Equipment supports.
 - 7. Non-penetrating rooftop bases.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water with no load transmitted to connected equipment.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include product data for components:
 - 1. Trapeze pipe hangers.
 - 2. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers, include analysis data signed and sealed by a qualified professional engineer responsible for their preparation.

1.4 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For tapes, as determined by testing identical products according to ASTM E84, by a testing agency acceptable to Authorities Having Jurisdiction. Factory label tapes with appropriate markings of applicable testing agency.

1. Tape Installed in Return Plenums: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Tape Installed Elsewhere: No testing requirement.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers shall be one of the following unless noted otherwise:
1. Anvil International.
 2. B-Line.
 3. Elcen.
 4. Grinnell.
 5. Kin-Ling.
 6. Michigan Hanger Co.
 7. National Pipe Hanger Corp.
 8. PHD Manufacturing.
 9. PHS Industries.
 10. Pipe Technology Products.
 11. Unistrut.

2.2 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 3. Non-Metallic 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 or stainless steel.
- B. Stainless-Steel Pipe Hangers and Supports:
1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.3 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. Pregalvanized components or hot dip galvanize entire assembly after fabrication where indicated.

2.4 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Hot or Cold Piping: ASTM C552, Type II cellular glass with 100-psig or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

- B. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- C. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- D. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.
- E. Shield: Shields shall be a minimum of 18 gauge galvanized steel, 12 inches long for piping 6 inches and smaller. Shields shall be a minimum of 16 gauge galvanized steel, 18 inches long for pipe over 6 inches.

2.5 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.
- B. Bushings: Plastic, flame retardant bushings may be used at penetrations of steel stubs and steel clips.

2.6 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes. Pregalvanized components or hot dip galvanize entire assembly after fabrication where indicated.

2.7 NON-PENETRATING ROOFTOP BASES

- A. Subject to compliance with requirements, manufacturers shall be one of the following:
 - 1. Roof Top Blox.
 - 2. Miro Industries, Inc.
- B. Description: Stainless-steel or polycarbonate bases designed for direct placement on roofing membrane.
 - 1. General:
 - a. All edges and corners in contact with the roof surface shall be rounded to prevent damage to the roof membrane.
 - b. Drainage ports shall be provided to prevent ponding of water within the base.
 - c. The bottom of the base shall be solid and flat, free of voids and deformities to prevent concentrated loading of the roofing membrane.
 - d. Polycarbonate bases shall be UV stabilized with carbon black.
 - 2. Supports: Pipe and equipment supports mounted to roof bases shall be constructed as outlined above. Integral supports for small diameter piping and conduit may be integral with polycarbonate bases.
 - 3. Protective Pads: 1/8 inch thick, flexible, PVC with carbon black additive for UV stabilization, protective pad for placement beneath roof bases to protect roofing membrane.

2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Tape for Plenum Use:

1. Polypropylene backing with acrylic adhesive, Hart & Cooley Part Number 011371.
2. Polyethylene coated cloth backing with rubber adhesive, Uline Black Nashua 398 Duct Tape, Model Number S-17236BL.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 2. Field fabricate from ASTM A36/A36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 plumbing fixture sections for requirements for pipe positioning systems for plumbing fixtures.
- E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- H. Install lateral bracing with pipe hangers and supports to prevent swaying.
- I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

L. Insulated Piping:

1. Attach clamps and spacers to piping.
 - a. Piping Operating Above Ambient Air Temperature: Clamp may not project through insulation except riser clamp.
 - 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:

	Length	Thickness
NPS 1/4 to NPS 3-1/2	12 inches	0.048 inch
NPS 4	12 inches	0.06 inch
NPS 5 & NPS 6	18 inches	0.06 inch
NPS 8 to NPS 14	24 inches	0.075 inch
NPS 16 to NPS 2	24 inches	0.105 inch

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place non-shrink grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

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

3.5 PAINTING

- A. Refer to General Provisions for rust inhibiting primer.
- B. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- C. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 specifications.
- D. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system sections.
- C. Wrap copper piping with not less than two layers of 10-mil-thick black plastic tape extending a minimum of 1 inch on each side of clamp for electrolytic protection where hangers or supports are in direct contact with copper piping.
- D. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications. Provide galvanized coating on all hangers and supports outside the insulated building envelope.
- E. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment 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 non-insulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1,050°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. 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.
 5. Single-Pipe Rolls (MSS Type 43): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
 6. 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.
 7. 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.
- 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).
 2. Steel Clevises (MSS Type 14): For 120 to 450°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. Include retaining clip.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lbs.
 - b. Medium (MSS Type 32): 1,500 lbs.
 - c. Heavy (MSS Type 33): 3,000 lbs.

8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- 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. Roof Bases: Unless otherwise indicated, install roof bases for roof-mounted piping and equipment as follows:
1. Select roof base size based on expected load to prevent crushing of the roofing membrane and underlying insulation.
 2. Space roof bases as required to properly support pipes or more frequently to distribute the weight of the supported systems to prevent damage to the roofing membrane, underlying insulation, or roofing system.
 3. Provide protective pads between each roof base and the roofing membrane. Size pads to extend a minimum of 2 inches beyond each roof base.
- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
- O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system sections.
- P. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION

Edition 0907-1015

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING & EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.

1.2 SUBMITTAL

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

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8-inch thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: Black.
 - 3. Background Color: White.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160°F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2" x 3/4".
 - 6. Minimum Letter Size: 1/2 inch. Include secondary lettering 3/8 inch.
 - 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's drawing designation or unique equipment number, and area(s) served by equipment. Coordinate with Owner.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8-inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Red.
- D. Maximum Temperature: Able to withstand temperatures up to 160°F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2" x 3/4".

- F. Minimum Letter Size: 1/2 inch. Include secondary lettering 3/8 inch.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: As indicated on drawings or required by local authority.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
 - 1. Complying with latest edition of ANSI/ASME A13.1 unless specifically noted otherwise or directed by Owner.
- B. Pretensioned Pipe Labels: Precoiled, semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Strap-On Pipe Labels: Semi-rigid plastic formed to fit circumference of pipe and to attach to pipe with stainless-steel worm-drive clamps.
- 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 PAINTED PIPE LABELS

- A. Paint: Alkyd paint selected for use without a primer based on base material.
- B. Color: Match background color indicated in Label Color Schedules below.
- C. Application: Use stencils for paint application.
- D. Lettering Size: At least 3 inches high.
- E. Flow Arrows: To show flow direction.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 EQUIPMENT LABEL INSTALLATION

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

- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Comply with requirements in latest edition of ASNI/ASME 13.1 unless noted otherwise.
- B. 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. 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 20 feet along each run. Reduce intervals to 10 feet in areas of congested piping and equipment. Reduce spacing to 5 feet when required by code.
 - 7. Spaced at maximum 10 feet on piping above removable acoustical ceilings. Reduce spacing to 5 feet when required by code.
- C. Use painted pipe labels outside where piping is exposed to weather.
 - 1. Apply one or two coats using the same stencil as required for thorough coverage.
 - 2. Sanitary Waste and Storm Drainage Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.

3.4 ADJUSTING AND CLEANING

- A. Relocate plumbing identification materials and devices that have become visually blocked by other work.
- B. Clean faces of plumbing identification devices.

END OF SECTION

Edition 0605-0216

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SECTION 22 07 19

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes insulating the following plumbing piping services:
 - 1. Domestic hot water piping.
 - 2. Domestic recirculating hot water piping.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated, include manufacturer's technical data with proposed thickness and R-value indicated as well as proposed application.

1.3 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E84 by a testing agency acceptable to Authorities Having Jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- B. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C871.
- C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.
- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- E. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534, Type I for tubular materials.

1. Manufacturers: Subject to compliance with requirements, provide product by one of the following manufacturers:
 - a. Armacell LLC.
 - b. K-Flex USA.

F. Mineral-Fiber, Pre-Formed Pipe Insulation:

1. Manufacturers: Subject to compliance with requirements, provide product by one of the following manufacturers:
 - a. Certainteed Corp.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation.
 - d. Owens Corning.
2. Mineral-Fiber, Pre-Formed Pipe Insulation:
 - a. Type I, 850°F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547, Type I, Grade A, with factory-applied ASJ or with factory-applied ASJ-SSL. Omit jacket on all but outermost layer where multiple insulation layers are required. Jacket shall comply with the following:
 - 1) ASJ: White, kraft paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
 - 2) ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.

G. Removable Insulation Wrap:

1. Manufacturers: Subject to compliance with requirements, provide product by No Sweat.
2. Removable Insulation Wrap:
 - a. Insert: Mineral or glass fibers bonded with a thermosetting resin with a minimum k-factor of 0.26 suitable for use up to 450°F. Maximum flame spread index of 25 and maximum smoke developed index of 50 per ASTM E84. Insert thickness to match thickness of adjacent insulation.
 - b. Outer Jacket: Tychem wrap consisting of Tyvek fabric made of spunbonded polyolefin with a polyethylene coating to limit vapor permeability. Jacket shall be provided with elastic banding at the ends and a reclosable hook and loop closure system at the seam. Maximum flame spread index of 25 and maximum smoke developed index of 50 per ASTM E84.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.

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 Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less as tested in accordance with ASTM E84.
3. Wet Flash Point: Below 0°F.
4. Service Temperature Range: 40 to 200°F.
5. Color: Black.

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. For indoor applications, use adhesive that has 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. Water-Vapor Permeance: ASTM E96/E96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
2. Service Temperature Range: -20 to +180°F.
3. Solids Content: ASTM D1644, 58% by volume and 70% by weight.
4. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Water-Vapor Permeance: ASTM F1249, 1.8 perms at 0.0625-inch dry film thickness.
2. Service Temperature Range: -20 to +180°F.
3. Solids Content: 60% by volume and 66% by weight.
4. Color: White.

2.5 SEALANTS

A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: -100 to +300°F.
4. Color: White or gray.

5. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. FSK and Metal Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: -40 to +250°F.
4. Color: Aluminum.
5. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants, and Vinyl, and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: -40 to +250°F.
4. Color: To match jacket.
5. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Polyester Fabric: Approximately 1 oz./sq.yd. with a thread count of 10 strands x 10 strands/sq.in., in a Leno weave, for pipe.

2.7 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C921, Type I, unless otherwise indicated.

- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Adhesive: As recommended by jacket material manufacturer.
2. Color: As scheduled below.
3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

- C. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

1. Finish and thickness are indicated in field-applied jacket schedules.
2. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
3. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
4. Factory-Fabricated Fitting Covers:
 - a. Same material, finish, and thickness as jacket.
 - b. Pre-formed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - c. Tee covers.
 - d. Flange and union covers.

- e. End caps.
- f. Beveled collars.
- g. Valve covers.
- h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
 - 1. Width: 3 inches.
 - 2. Thickness: 11.5 mils.
 - 3. Adhesion: 90 ounces force/inch in width.
 - 4. Elongation: 2%.
 - 5. Tensile Strength: 40 lbf/inch in width.
 - 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
 - 1. Width: 2 inches.
 - 2. Thickness: 6 mils.
 - 3. Adhesion: 64 ounces force/inch in width.
 - 4. Elongation: 500%.
 - 5. Tensile Strength: 18 lbf/inch in width.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
 - 1. Width: 2 inches.
 - 2. Thickness: 3.7 mils.
 - 3. Adhesion: 100 ounces force/inch in width.
 - 4. Elongation: 5%.
 - 5. Tensile Strength: 34 lbf/inch in width.

2.9 SECUREMENTS

- A. Aluminum Bands: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.
- B. Staples: Outward-clinching insulation staples, nominal 3/4 inch wide, stainless steel or Monel.
- C. Wire: 0.062 inch, soft-annealed, stainless steel.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Install insulation continuously through hangers and around anchor attachments.
 - 1. At pipe guides, secure spider to pipe and apply insulation through spider per the guide manufacturer's recommendations.
- K. 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.
- L. 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.
- M. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. 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.
- N. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- O. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- P. Cut insulation in a manner to avoid compressing insulation more than 75% of its nominal thickness.
- Q. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- R. 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.
- S. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Cleanouts.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends below roof surface. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends inside building. 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 Division 07 specifications 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 specifications for firestopping and fire-resistive joint sealers.
- ### 3.4 GENERAL PIPE INSULATION INSTALLATION
- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using pre-formed 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 pre-formed 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 pre-formed 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 2 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 pre-formed 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 2 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 pre-formed pipe insulation. Overlap adjoining pipe insulation by not less than 2 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.
10. Contractor's Option for Valves and Strainers: Removable insulation wrap system.

a. Below Ambient Systems or where a Vapor Barrier is Specified:

- 1) Provide PVC tape around ends of wrap system to seal wrap to adjacent pipe insulation.
- 2) Provide PVC tape closure along seam. Center tape to overlap seam.

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 at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install pre-formed valve covers manufactured of same material as pipe insulation when available.
2. When pre-formed 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.

3.6 INSTALLATION OF MINERAL-FIBER PRE-FORMED PIPE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of pre-formed 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 pre-formed 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 pre-formed sections of same material as straight segments of pipe insulation when available.
2. When pre-formed 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 pre-formed sections of same material as straight segments of pipe insulation when available.

2. When pre-formed 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.
- B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.8 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable pre-formed 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, except hot water return and hot water piping.
 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.9 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Hot and Recirculated Hot Water, 140°F and Lower, Piping:
 1. Insulation shall have a maximum K-factor of 0.28 at a mean rating temperature of 100°F and be one of the following:
 - a. Flexible Elastomeric: 1 inch thick for piping less than 1-1/2 inches; Not permitted for piping 1-1/2 inches and larger.
 - b. Mineral-Fiber, Pre-Formed Pipe Insulation, Type I: 1 inch thick for piping less than 1-1/2 inches; 1-1/2 inches thick for piping 1-1/2 inches and larger.
- B. Domestic Hot and Recirculated Hot Water, 140°F and Lower, Piping:
 1. Mineral-Fiber, Pre-Formed Pipe Insulation, Type I shall have a maximum K-factor of 0.28 at a mean rating temperature of 100°F and be the following:
 - a. Mineral-Fiber, Pre-Formed Pipe Insulation, Type I: 1-1/2 inches thick for piping less than 1-1/2 inches; 2 inches thick for piping 1-1/2 inches and larger.

3.10 UNDERGROUND PIPING INSULATION SCHEDULE

- A. Domestic Hot and Recirculated Hot Water, 140°F and Less, Piping:
 - 1. Flexible Elastomeric Insulation with a Maximum K-Factor of 0.28 at a Mean Rating Temperature of 100°F: 1 inch thick for piping less than 1-1/2 inches; 1-1/2 inches thick for piping 1-1/2 inches and larger.

3.11 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: None.
- D. Piping, Exposed:
 - 1. PVC: 20 mils thick.
 - a. Color: White.
 - 2. Aluminum, Smooth or Corrugated: 0.016 inch thick.

3.12 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: None.
- D. Piping, Exposed: Aluminum, smooth or corrugated with Z-shaped locking seam, 0.020 inch thick.

END OF SECTION

Edition 0908-03/21

SECTION 22 11 16
DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes:
 - 1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
 - 2. Specialty valves.
 - 3. Flexible connectors.

1.2 DEFINITIONS

- A. Domestic Water: Includes softened and un-softened domestic hot and cold water.

1.3 SUBMITTALS

- A. Product Data: For each type of pipe and joining material, and for method for joining piping intended for the project.
- B. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 61 Annex G or NSF 372 for low-lead potable domestic water piping and components.

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 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B88, Type L water tube, drawn temper.
 - 1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
 - 2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 - 4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- B. Soft Copper Tube: ASTM B88, Type K and ASTM B88, Type L water tube, annealed temper.

1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.2.1, non-metallic and asbestos-free, unless otherwise indicated; 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 B32, lead-free alloys. Include water-flushable flux according to ASTM B813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 TRANSITION FITTINGS

- A. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

2.5 DIELECTRIC FITTINGS

- A. Dielectric Nipples: Galvanized- or electroplated-steel, or ductile iron nipple with inert and non-corrosive thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225°F.
- B. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating non-conductive insulating material suitable for system fluid, pressure, and temperature.

1. Dielectric Flanges:

- a. Factory-fabricated, bolted, companion-flange assembly.
- b. Pressure Rating: 150 psig.
- c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

2. Dielectric-Flange Kits:

- a. Non-conducting materials for field assembly of companion flanges.
- b. Pressure Rating: 150 psig.
- c. Gasket: Neoprene or phenolic.
- d. Bolt Sleeves: Phenolic or polyethylene.
- e. Washers: Phenolic with steel backing washers.

2.6 FLEXIBLE CONNECTORS

- A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 1. Working-Pressure Rating: Minimum 200 psig.
 2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
 3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

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.
- B. Install copper tubing under building slab according to CDA's Copper Tube Handbook.
- C. Install piping buried below the building slab a minimum of 24 inches below slab.
- D. Install underground piping outside of the building footprint a minimum of 24 inches below finished grade or minimum of 12 inches below the local frostline, whichever is deeper.
- E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance.
- F. Install shutoff valve immediately upstream of each dielectric fitting.
- G. Install water-pressure-reducing valves downstream from shutoff valves where facility incoming water pressure exceeds 80 psi.
- H. Install domestic water piping level and plumb.
- I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- K. 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.
- L. Do not install piping within electrical rooms, elevator equipment rooms, MDF or IDF rooms, or stairwells. Exception: Pipe supplying equipment serving the room. Maintain all required clearances to other equipment.
- M. Do not install piping above electrical equipment such as transformers, panels, motor control centers, etc., in other rooms.
- N. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- O. Install piping adjacent to equipment and specialties to allow service and maintenance.
- P. Install piping to permit valve servicing.
- Q. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- R. Install piping free of sags and bends.

- S. Install factory fabricated fittings for changes in direction and branch connections.
- T. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- U. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Specification Section 22 05 19, Meters and Gages for Plumbing Piping, for pressure gages.
- V. Install thermostats in hot-water circulation piping. Comply with requirements in Specification Section "Domestic Water Pumps" for thermostats.
- W. Install thermometers on outlet piping from each water heater. Comply with requirements in Specification Section 22 05 19, Meters and Gages for Plumbing Piping, for thermometers.
- X. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Specification Section 22 05 17, Sleeves and Sleeve Seals for Plumbing Piping.
- Y. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Specification Section 22 05 17, Sleeves and Sleeve Seals for Plumbing Piping.
- Z. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Specification Section 22 05 18, 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: Join copper tube and fittings according to CDA's Copper Tube Handbook, Brazed Joints Chapter.
- E. Soldered Joints: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B828 or CDA's Copper Tube Handbook.
- F. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Flanged Joints: Select appropriate asbestos-free, non-metallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

- H. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.3 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Specification Section 22 05 23, General-Duty Valves for Plumbing Piping, for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball valves for piping NPS 4 and smaller. Use gate valves for piping NPS 5 and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Specification Section 22 11 19, Domestic Water Piping Specialties.
 - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
 - 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.
- D. Install balancing valve in each hot-water circulation return branch and where indicated on the drawings. Set balancing valves partly open to restrict but not stop flow. Comply with requirements in Specification Section 22 11 19, Domestic Water Piping Specialties, for balancing valves.

3.4 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.

3.5 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.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
- D. Dielectric Fittings for NPS 5 to NPS 6: Use dielectric flange kits.

3.6 FLEXIBLE CONNECTOR INSTALLATION

- A. Install flexible connectors in suction and discharge piping connections to each domestic water booster pump.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Specification Section 22 05 29, Hangers and Supports for Plumbing Piping and Equipment, for pipe hanger and support products and installation.
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: MSS Type 1, adjustable, steel clevis hangers.
 - 3. Multiple, Straight, Horizontal Piping Runs: Trapeze hangers with pipe clamps.
- B. Support vertical piping and tubing at base and at each floor.

- C. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- 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:

	Maximum Horizontal Spacing	Minimum Rod Diameter
NPS 3/4 & Smaller	60 inches	3/8-inch rod
NPS 1 & NPS 1-1/4	72 inches	3/8-inch rod
NPS 1-1/2 & NPS 2	96 inches	3/8-inch rod
NPS 2-1/2	108 inches	1/2-inch rod
NPS 3 to NPS 5	10 feet	1/2-inch rod
NPS 6	10 feet	5/8-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.

3.8 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture sections for connection sizes.
 - 4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.
 - 5. Install automatic trap primers on the cold water supply at the nearest fixture (or where indicated on the drawings) and run drain to trap seal being protected. Provide wall access panel when primers are installed in walls.

3.9 IDENTIFICATION

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

3.10 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Inspections:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by Authorities Having Jurisdiction (AHJ).
2. During installation, notify the AHJ at least 1 day before inspection must be made. Perform tests specified below in presence of the AHJ:
 - a. Roughing-In Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for the AHJ to observe tests specified below and to ensure compliance with requirements.
3. Re-Inspection: If the AHJ finds that piping will not pass tests or inspections, make required corrections and arrange for re-inspection.
4. Reports: Prepare inspection reports and have them signed by the AHJ.

C. Piping Tests:

1. Fill domestic water piping using clean, potable water. Check components to determine that they are not air bound and that piping is full of water.
2. 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.
3. 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.
4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.
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 for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.11 CLEANING

A. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

B. Clean and disinfect potable domestic water piping prior to putting into service as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before use with clean, potable water.

2. Use purging and disinfecting procedures prescribed by the AHJ; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for 3 hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to the AHJ for testing of piping cleanliness. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities to Architect/Engineer. Include a copy of final report in Operation and Maintenance Manual.

3.12 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Underground, domestic water, building service piping shall be:
 1. Piping NPS 2 and Smaller: Soft copper tube, ASTM B88, Type K; wrought-copper solder-joint fittings; and brazed joints.
 2. Piping NPS 2-1/2 and Larger: Hard copper tube, ASTM B88, Type K; wrought-copper solder-joint fittings; and brazed joints.
- D. Under-building-slab, domestic water piping shall be:
 1. Piping NPS 2 and Smaller: Soft copper tube, ASTM B88, Type L; without joints.
 2. Piping NPS 2-1/2 and Larger: Hard copper tube, ASTM B88, Type L; wrought-copper solder-joint fittings; and brazed joints.
 3. All under slab copper tube shall be protected with 20-mil plastic sleeving. Use blue sleeving on cold water piping and red sleeving for hot water piping. Sleeving shall extend a minimum of 2 inches above slab.
- E. Aboveground domestic water piping, NPS 2 and smaller shall be the following:
 1. Hard copper tube, ASTM B88, Type L; cast- or wrought- copper solder-joint fittings; and soldered joints.
- F. Aboveground domestic water piping, NPS 2-1/2 to NPS 4 shall be the following:
 1. Hard copper tube, ASTM B88, Type L; cast- or wrought- copper solder-joint fittings; and soldered joints.

G. Aboveground domestic water piping, NPS 5 and NPS 6 shall be the following:

1. Hard copper tube, ASTM B88, Type L; cast- or wrought- copper solder-joint fittings; and brazed joints.

3.13 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball valves for piping NPS 4 and smaller. Use gate valves with flanged ends for piping NPS 5 and larger.
2. Throttling Duty: Use ball valves for piping NPS 4 and smaller. Use butterfly valves with flanged ends for piping NPS 5 and larger.
3. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.
4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION

Edition 0308-1015

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SECTION 22 11 19

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following domestic water piping specialties:

1. Backflow preventers.
2. Balancing valves.
3. Temperature-actuated water mixing valves.
4. Strainers.
5. Hose bibbs.
6. Wall hydrants.
7. Drain valves.
8. Water hammer arresters.
9. Trap-seal primer valves.

1.2 PERFORMANCE REQUIREMENTS

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

1.3 SUBMITTALS

A. Product Data: For each type of water piping specialty proposed for this project. Include manufacturer, model number, materials of construction, options and accessories, etc.

1. For thermostatic mixing valves include a copy of the piping diagram.

B. Field quality-control test reports.

C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. NSF Compliance:

1. Comply with NSF 14, Plastics Piping Components and Related Materials, for plastic domestic water piping components.
2. Comply with NSF 61 Annex G for low-lead requirements.

PART 2 - PRODUCTS

2.1 BACKFLOW PREVENTERS

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

1. Conbraco Industries, Inc.

2. FEBCO.
3. Watts Industries, Inc.; Water Products Division.
4. Wilkins.

B. Reduced-Pressure-Principle Backflow Preventers:

1. Standard: ASSE 1013.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 12 psig maximum, through middle one-third of flow range.
4. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved, steel with interior lining complying with AWWA C550 or that is FDA approved, or stainless steel for NPS 2-1/2 and larger.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
6. Configuration: Designed for horizontal, straight through flow.
7. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
 - b. Wye Pattern Strainer.
 - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

C. Backflow Preventers for Carbonated Beverage Dispensers:

1. Standard: ASSE 1022.
2. Body: Stainless steel.
3. Style: Dual check with atmospheric port.
4. Operation: Continuous-pressure applications.
5. End Connections: Threaded or flared.
6. Configuration: Designed for horizontal or vertical installation, straight through flow.

2.2 BALANCING VALVES

A. Temperature Actuated, Automatic Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. ThermOmegaTech.
2. Body: Type 303 stainless steel.
3. Plug: Type 303 stainless steel.
4. Thermal Actuator: Type 303 stainless steel.
5. Spring: Type 302 stainless steel.
6. End Connections: Threaded.
7. CWP Rating: Minimum 200 psig.
8. Maximum Operating Temperature: 250°F.
9. Valve Selection: Select automatic balancing valve closing temperature to match the mixing station outlet temperature indicated on the drawings rounded down to the nearest 5°F increment. Valve size is indicated on the drawings.
10. Options: Provide the following factory options:
 - a. Stainless-steel union connection with O-ring to allow for valve removal and integrated check valve.
 - b. Inlet and outlet full-port, lead-free, bronze ball valves with threaded ends.

- c. Integrated strainer.

2.3 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Point-of-Use, Water-Temperature Limiting Devices:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on the drawings or a comparable product by one of the following:
 - a. Bradley.
 - b. Conbraco Industries, Inc.
 - c. Lawler Manufacturing Company, Inc.
 - d. Powers.
 - e. Symmons Industries, Inc.
 - f. Watts Industries, Inc.
 - g. Wilkins.
2. Standard: ASSE 1070.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled, pressure balanced water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded or union inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: 110°F.
9. Tempered-Water Design Flow Rate: 0.5 gpm to 2.5 gpm.
10. Valve Finish: Chrome plated where exposed, rough bronze where concealed.

B. Primary, Thermostatic, Water Mixing Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on the drawings or a comparable product by one of the following:
 - a. Bradley.
 - b. Lawler Manufacturing Company, Inc.
 - c. Powers.
 - d. Symmons Industries, Inc.
 - e. Wilkins.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Cabinet-type, thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded or union inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
9. Pressure Drop at Design Flow Rate: 25 psig.
10. Valve Finish: Rough bronze.
11. Piping Finish: Copper.
12. Cabinet: Factory-fabricated, stainless steel, for surface mounting and with hinged, stainless-steel door.

2.4 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.020 inch.
 - b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
 - c. Strainers NPS 5 and Larger: 0.10 inch.
6. Drain: Pipe plug.

2.5 HOSE BIBBS

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

1. Chicago.
2. MIFAB, Inc.
3. Prier Product, Inc.
4. Jay R. Smith Manufacturing Co.
5. Watts Drainage Products Inc.
6. Woodford Manufacturing Company.
7. Zurn.

B. Standard: ASME A112.18.1 for lawn and sediment faucets.

C. Body Material: Bronze.

D. Seat: Bronze, replaceable.

E. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet as indicated on the drawings.

F. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.

G. Pressure Rating: 125 psig.

H. Vacuum Breaker: Integral non-removable, drainable, hose-connection vacuum breaker complying with ASSE 1011.

I. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.

J. Finish for Service Areas: Rough bronze.

K. Finish for Finished Rooms: Chrome or nickel plated.

L. Operation for Equipment Rooms: Wheel handle or operating key.

M. Operation for Service Areas: Operating key.

- N. Operation for Finished Rooms: Operating key.
- O. Include operating key with each operating-key hose bibb.
- P. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.6 WALL HYDRANTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Chicago.
 - 2. MIFAB, Inc.
 - 3. Prier Product, Inc.
 - 4. Jay R. Smith Manufacturing Co.
 - 5. Watts Drainage Products Inc.
 - 6. Woodford Manufacturing Company.
 - 7. Zurn.
- B. Moderate-Climate Wall Hydrants:
 - 1. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
 - 2. Pressure Rating: 125 psig.
 - 3. Operation: Loose key.
 - 4. Inlet: NPS 3/4 or NPS 1 as indicated on the drawings.
 - 5. Outlet: Concealed, with integral vacuum breaker or non-removable hose-connection and garden-hose thread complying with ASME B1.20.7.
 - 6. Box: Deep, flush mounting with cover.
 - 7. Lock: Quarter-turn matched to operating key.
 - 8. Box and Cover Finish: Polished nickel bronze
 - 9. Operating Keys(s): One with each wall hydrant.

2.7 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.

2.8 WATER HAMMER ARRESTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. MIFAB, Inc.
 - 2. PPP Inc.
 - 3. Sioux Chief Manufacturing Company, Inc.

4. Jay R. Smith Manufacturing Co.
5. Watts Drainage Products Inc.
6. Zurn.

B. Standard: ASSE 1010 or PDI-WH 201.

C. Type: Metal bellows or copper tube with piston.

D. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.9 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves:

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

2.10 ELECTRONIC TRAP PRIMER VALVES

A. Supply Type, Electronic Trap Priming Assembly:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIFAB, Inc.
 - b. PPP Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Zurn Plumbing Products Group.
2. Standard: ASSE 1044.
3. Pressure Rating: 125 psig minimum.
4. Style: Recessed cabinet in finished locations and new construction. NEMA 1 cabinet in retrofit applications or unfinished areas with masonry walls.
5. Number of Openings: As required for application or as noted.
6. Inlet Connections: NPS 3/4 with shutoff valve.
7. Outlet Connection: 1/2-inch compression.
8. Backflow Prevention: Anti-siphon atmospheric vacuum breaker, ASSE 1001.
9. Electrical: 120V, 1 phase, circuit breaker, manual override, 24-hour timer, UL listed solenoid valve.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install backflow preventers in each water supply to equipment and water systems that may be sources of contamination. Comply with the AHJ.
 - 1. Locate backflow preventers in same room as connected equipment or system.
 - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 - 3. Do not install bypass piping around backflow preventers.
- B. Install balancing valves where indicated on the drawings in locations where they can be easily accessed.
- 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 water pressure-reducing valve, backflow preventer without integral strainer, solenoid valve, and pump.
 - 1. Install shut-off valve upstream and downstream of each strainer
- E. Install wall hydrants in exterior walls and other locations as noted on the drawings.
- F. Install wall hydrants in interior locations susceptible to vandalism or damage such as student areas in schools, loading docks, etc., and other locations as noted on the drawings.
- G. Install hose bibbs in interior locations not susceptible to vandalism and other locations as noted on the drawings.
- H. Install water hammer arresters in water piping according to PDI-WH 201.
- I. Install trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1%, and connect to floor-drain or floor-sink body, trap, or inlet fitting. Adjust valve for proper flow.
 - 1. Trap-seal primer valves are not required where barrier-type trap sealers are provided.
 - 2. Install trap primer valves at all floor drains or floor sinks where indicated on the drawings.
 - a. Install supply-type valves where floor drains and floor sinks are in close proximity to flush valves.
 - b. Install electronic valves where floor drains and floor sinks are not in close proximity to flush valves.
- J. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Reduced-pressure-principle backflow preventers.
 - 2. Water pressure-reducing valves.

3. Primary, thermostatic, water mixing valves.

- K. 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 Specification Section 22 05 53, Identification for Plumbing Piping and Equipment.

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:

1. Test each reduced-pressure-principle backflow preventer assembly according to the AHJ and the device's reference standard.

- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.3 ADJUSTING

- A. Set field-adjustable pressure setpoints of water pressure-reducing valves.

- B. Set field-adjustable temperature setpoints of water mixing valves.

- C. Set temperature limiting devices to a maximum of 120°F unless noted otherwise.

END OF SECTION

Edition 0605-1019

SECTION 22 11 23

DOMESTIC HOT WATER RECIRCULATING PUMPS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes:

1. In-line, seal-less centrifugal pumps.

1.2 SUBMITTALS

- A. Product Data: Provide manufacturer's product data for each unit indicated on the drawings. Data to be specific to the equipment proposed for the project with all options and accessories indicated. Include the following as a minimum:

1. Manufacturer and model number.
2. Rated capacity based on scheduled conditions.
3. Equipment dimensions.
4. Required clearances.
5. Electrical data.

- a. Motor horsepower.
- b. Voltage/Phase/Hz.

6. Materials of construction.
7. Accessories and options.
8. Controls.

- B. Warranty information.

- C. Operation and maintenance data.

1.3 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. UL Compliance: Comply with UL 778 for motor-operated water pumps.
- C. Hydraulic Institute Standards: HI 1.4.

PART 2 - PRODUCTS

2.1 IN-LINE, SEAL-LESS CENTRIFUGAL PUMPS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Armstrong Pumps Inc.

2. Grundfos Pumps Corp.
 3. TACO.
- B. Description: Factory-assembled and -tested, in-line, close-coupled, canned-motor, seal-less, overhung-impeller centrifugal pumps.
- C. Pump Construction:
1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal or vertical.
 2. Casing: Stainless steel with threaded or companion-flange connections.
 3. Impeller: Plastic or stainless steel.
 4. Motor: Single speed, unless otherwise indicated.
- D. Capacities and Characteristics:
1. Minimum Working Pressure: 125 psig.
 2. Maximum Continuous Operating Temperature: 220°F.
 3. Pump Control: Aquastat and timer.
 4. Electrical Characteristics:
 - a. Volts: 120.
 - b. Phases: Single.
 - c. Hertz: 60.

2.2 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Specification Section 22 05 13, Common Motor Requirements for Plumbing Equipment.
1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.3 CONTROLS

- A. Thermostats: Electric; adjustable for control of hot-water circulation pump.
1. Type: Water-immersion temperature sensor or pipe clamp-on, for installation in or on piping.
 2. Range: 50 to 125°F.
 3. Enclosure: NEMA 250, Type 4X.
 4. Operation of Pump: On or off.
 5. Transformer: Provide if required.
 6. Power Requirement: 24 VAC or 120 VAC.
 7. Settings: Start pump at 105°F and stop pump at 110°F.
- B. Timers: Electric, for control of hot-water circulation pump.
1. Type: Programmable, 7-day clock with manual override on-off switch.
 2. Enclosure: NEMA 250, Type 1 suitable for wall mounting.
 3. Operation of Pump: On or off.
 4. Transformer: Provide if required.
 5. Power Requirement: 24 VAC or 120 VAC.

6. Programmable Sequence of Operation: Up to two on-off cycles each day for 7 days.

PART 3 - EXECUTION

3.1 PUMP INSTALLATION

- A. Comply with HI 1.4.
- B. Install in-line, centrifugal pumps per manufacturer's recommendations.
- C. Install thermostats in or on hot-water return piping.
- D. Install timers on wall adjacent to pump or as indicated on the drawings.

3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Specification Section 22 11 16, Domestic Water Piping. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps to allow service and maintenance.
- C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
 1. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for valves specified in Specification Section 22 05 23, General-Duty Valves for Plumbing Piping, and comply with requirements for strainers specified in Specification Section 22 11 19, Domestic Water Piping Specialties.
 2. Install a single pressure gage at each pump connected to the suction and discharge of each pump with valves to allow for individual measurement of pump pressures. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Comply with requirements for pressure gages and snubbers specified in Specification Section 22 05 19, Meters and Gages for Plumbing Piping.
- D. Connect aquastats and timers to pumps that they control.

3.3 ADJUSTING

- A. Adjust domestic water pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust initial temperature setpoints.
- C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION

Edition 0307-0416

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SECTION 22 13 16

SANITARY WASTE & VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes:
 - 1. Pipe, tube, and fittings.
 - 2. Specialty pipe fittings.

1.2 DEFINITIONS

- A. Grease Waste Piping: Waste piping upstream of grease interceptor or grease trap.

1.3 SUBMITTALS

- A. Product Data: For each type of pipe and joining material, and for method for joining piping intended for the project.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in the Piping Schedule article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 EPOXY-COATED, HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A888 or CISPI 301, coated inside and out with a fusion bonded epoxy coating complying with Sections 4.6 and 5.7 of European Standard EN 877.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Charlotte Pipe and Foundry.
 - b. NewAge Casting.
- B. Epoxy Tape: Butyl rubber tape with polypropylene fleece cover. Furnished by the pipe manufacturer, used to cover uncoated ends of pipe after cutting.
- C. Heavy-Duty, Hubless-Piping Couplings:
 - 1. Product: Subject to compliance with requirements, provide one of the following products:
 - a. ANACO-Husky, SD 4000.

- b. Ideal Clamp Products, Ideal Tridon Heavy Duty HD Coupling.
 - c. Mission, HeavyWeight Coupling.
 - 2. Standards: ASTM C1540.
 - 3. Description: Type 304 stainless-steel shield with minimum four stainless-steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.
- D. Standard-Duty, Hubless-Piping Couplings:
- 1. Product: Subject to compliance with requirements, provide one of the following products:
 - a. ANACO, No Hub Coupling.
 - b. Ideal Clamp Products, Ideal Tridon Standard Duty Coupling.
 - c. Mission, No Hub Coupling.
 - 2. Standards: ASTM C1277.
 - 3. Description: Type 301 stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.

2.3 COPPER TUBE AND FITTINGS

- A. Copper DWV Tube: ASTM B306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought-copper, solder-joint fittings.
- C. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
 - 1. Flange Gasket Materials: ASME B16.21, full-face, flat, non-metallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- D. Solder: ASTM B32, lead-free with ASTM B813, water-flushable flux.

2.4 HUB-AND-SPIGOT, STAINLESS-STEEL SOIL PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Blucher.
 - 2. Josam Company.
- B. Standard: ANSI/ASME A112.3.1.
- C. Description: Type 316L, lightweight, welded-seam, stainless-steel push-fit pipe and fittings.
- D. Gaskets: EPDM rubber fit in hub end of pipe and fittings.
- E. Fittings: DWV pattern to match piping.

2.5 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Standard: ASTM C1460.
4. Description: Rubber sleeve with full-length, stainless-steel shield and stainless-steel bands with tightening mechanism.
5. Shielded, Non-Pressure Transition Couplings:

a. Copper Piping to Plastic Piping:

- 1) Product: Subject to compliance with requirements, provide the following product:
 - a) Fernco Proflex.
 - b) Mission Band-Seal.

b. Cast Iron Piping to Plastic Piping:

- 1) Product: Subject to compliance with requirements, provide the following product:
 - a) ANACO-Husky, SD 4200.

c. Cast Iron Piping to Copper Piping:

- 1) Product: Subject to compliance with requirements, provide the following product:
 - a) Fernco Proflex.
 - b) Mission Band-Seal.

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.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

- D. Do not install piping within electrical rooms, elevator equipment rooms, MDF or IDF rooms, or stairwells. Exception: Pipe supplying equipment serving the room. Maintain all required clearances to other equipment.
- E. Do not install piping above electrical equipment such as transformers, panels, motor control centers, etc., in other rooms.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back-to-back or side-by-side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees.
- J. Use standard pipe increasers and reducers if pipes of different sizes are connected. Do not use bushings. Reducing size of drainage piping in direction of flow is prohibited.
- K. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- L. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
 - 1. Horizontal Sanitary Drainage Piping: 1/4 inch per foot, 2% downward in direction of flow unless noted otherwise.
 - 2. Vent Piping: 1/8 inch per foot, 1% 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.
- N. Install aboveground copper tubing according to CDA's Copper Tube Handbook.
- O. Install stainless-steel piping in accordance with the manufacturer's written instructions.
- P. Plumbing Specialties:
 - 1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Comply with requirements for cleanouts specified in Specification Section 22 13 19, Sanitary Waste Piping Specialties.
 - 2. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Specification Section 22 13 19, Sanitary Waste Piping Specialties.
- Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by Authorities Having Jurisdiction (AHJ).

- R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Specification Section 22 05 17, Sleeves and Sleeve Seals for Plumbing Piping.
- S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Specification Section 22 05 17, Sleeves and Sleeve Seals for Plumbing Piping.
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Specification Section 22 05 18, 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.
 - 1. In corrosive applications such as: grease waste; dialysis treatment waste; bar, liquor, or soda waste; food processing waste; healthcare waste; or where noted on the drawings, cover cut ends with epoxy tape to cover exposed cast iron per the pipe manufacturer's written instructions.
- B. Join copper tube and fittings with soldered joints according to ASTM B828. Use ASTM B813, water-flushable, lead-free flux and ASTM B32, lead-free-alloy solder.
- C. Join hub-and-spigot, stainless-steel soil piping with gasket joints according to the manufacturer's written instructions and the following:
 - 1. Make all cuts square.
 - 2. Remove burrs.
 - 3. Confirm gasket is in place and not damaged before making joints.
 - 4. Apply lubricant as recommended by the manufacturer.
- D. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

3.3 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in ODs.
 - 2. In Drainage Piping: Non-pressure transition couplings.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger and support devices and installation specified in Specification Section 22 05 29, Hangers and Supports for Plumbing Piping and Equipment.
 - 1. Install carbon-steel pipe hangers for horizontal piping in non-corrosive environments.
 - 2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
 - 3. Install carbon-steel pipe support clamps for vertical piping in non-corrosive 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. Individual, Straight, Horizontal Piping Runs: MSS Type 1, adjustable, steel clevis hangers.

7. Multiple, Straight, Horizontal Piping Runs: Trapeze hangers with pipe clamps.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

- B. Support each section of horizontal piping and tubing within 12 inches of each fitting and coupling.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

	Maximum Horizontal Spacing	Minimum Rod Diameter
NPS 1-1/2 & NPS 2	60 inches	3/8-inch rod
NPS 3	60 inches	1/2-inch rod
NPS 4 & NPS 5	60 inches	5/8-inch rod
NPS 6 & NPS 8	60 inches	3/4-inch rod

Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

- F. Install supports for vertical cast-iron soil piping every 15 feet.
- G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

	Maximum Horizontal Spacing	Minimum Rod Diameter
NPS 1-1/4	72 inches	3/8-inch rod
NPS 1-1/2 & NPS 2	96 inches	3/8-inch rod
NPS 2-1/2	108 inches	1/2-inch rod
NPS 3 & NPS 5	10 feet	1/2-inch rod
NPS 6	10 feet	5/8-inch rod
NPS 8	10 feet	3/4-inch rod

- H. Install supports for vertical copper tubing every 10 feet.
- I. Install hangers for stainless-steel soil piping with the following maximum horizontal spacing and minimum rod diameters:

	Maximum Horizontal Spacing	Minimum Rod Diameter
NPS 1-1/2 & NPS 4	120 inches	3/8-inch rod
NPS 5 & NPS 8	120 inches	1/2-inch rod
NPS 10 & NPS 12	120 inches	5/8-inch rod

- J. Install supports for vertical stainless-steel piping every 10 feet.
- K. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 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 the AHJ.
 - 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 Specification Section 22 13 19, Sanitary Waste Piping Specialties.
 - 6. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections according to the following unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.6 IDENTIFICATION

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

3.7 FIELD QUALITY CONTROL

- A. During installation, notify the AHJ at least 24 hours before inspection must be made. Perform tests specified below in the presence of the AHJ.
 - 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 the AHJ to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If the AHJ finds 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 the AHJ.

- D. Test sanitary drainage and vent piping according to the procedures of the AHJ 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. Water level must not drop for 4 hours. Inspect joints for leaks and make all necessary repairs.
 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 but no less than 30 minutes. 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.

3.8 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.

3.9 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground soil and waste piping NPS 4 and smaller shall be any of the following:
1. Epoxy-coated, hubless, cast-iron soil pipe and fittings; heavy-duty, 4-band hubless-piping couplings; and coupled joints.
 2. Copper DWV tube, copper drainage fittings, and soldered joints.
 3. Dissimilar Pipe-Material Couplings: Shielded, non-pressure transition couplings.
- C. Aboveground vent piping NPS 4 and smaller shall be any of the following:
1. Epoxy-coated, hubless, cast-iron soil pipe and fittings; standard-duty hubless-piping couplings; and coupled joints.
 2. Copper DWV tube, copper drainage fittings, and soldered joints.
 3. Dissimilar Pipe-Material Couplings: Shielded, non-pressure transition couplings.
- D. Aboveground soil and waste piping NPS 5 and larger shall be any of the following:
1. Epoxy-coated, hubless, cast-iron soil pipe and fittings; heavy-duty, 6-band hubless-piping couplings; and coupled joints.

2. Dissimilar Pipe-Material Couplings: Shielded, non-pressure transition couplings.
- E. Aboveground vent piping NPS 5 and larger shall be any of the following:
1. Epoxy-coated, hubless, cast-iron soil pipe and fittings; standard-duty hubless-piping couplings; and coupled joints.
 2. Dissimilar Pipe-Material Couplings: Shielded, non-pressure transition couplings.
- F. Underground soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
1. Epoxy-coated, hubless, cast-iron soil pipe and fittings; heavy-duty, 4-band hubless-piping couplings; and coupled joints.
 2. Stainless-steel soil pipe and fittings; gaskets; and gasketed joints.
 3. Dissimilar Pipe-Material Couplings: Shielded, non-pressure transition couplings.
- G. Underground soil, waste, and vent piping NPS 5 and larger shall be any of the following:
1. Epoxy-coated, hubless, cast-iron soil pipe and fittings; heavy-duty, 6-band hubless-piping couplings; and coupled joints.
 2. Stainless-steel soil pipe and fittings; gaskets; and gasketed joints.
 3. Dissimilar Pipe-Material Couplings: Shielded, non-pressure transition couplings.
- H. Aboveground soil and waste piping serving a kitchen or area where drain water temperatures will reach 140°F or above shall be:
1. Epoxy-coated, hubless, cast-iron soil pipe and fittings; heavy-duty, 4-band hubless-piping couplings; and coupled joints.
 2. Extend to grease interceptor or 50 feet beyond boundary of kitchen or area.
- I. Underground soil and waste piping serving a kitchen or area where drain water temperatures will reach 140°F or above shall be:
1. Epoxy-coated, hubless, cast-iron soil pipe and fittings; heavy-duty, 4-band hubless-piping couplings; and coupled joints.
 2. Stainless-steel soil pipe and fittings; gaskets; and gasketed joints.
 3. Extend to grease interceptor or 50 feet beyond boundary of kitchen or area.

END OF SECTION

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SECTION 22 13 19

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the following sanitary drainage piping specialties:

1. Cleanouts.
2. Floor drains.
3. Floor sinks.
4. Roof flashing assemblies.
5. Miscellaneous sanitary drainage piping specialties.
6. Flashing materials.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated, include manufacturer, model number, materials of construction, and options and accessories.

1.3 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Jay R. Smith Manufacturing Co.
2. Josam Company; Josam Division.
3. Sioux Chief Manufacturing Company, Inc.
4. Watts Drainage Products Inc.
5. Zurn Plumbing Products Group.

2.2 CLEANOUTS

- A. Exposed Cast-Iron Cleanouts:

1. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
2. Size: Same as connected drainage piping.
3. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure: Countersunk, plastic plug, except provide brass plug in return air plenums.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

- B. Cast-Iron Floor Cleanouts:

1. Standard: ASME A112.36.2M for adjustable housing cleanout.

2. Size: Same as connected branch.
3. Type: Adjustable housing.
4. Body or Ferrule: Cast iron.
5. Clamping Device: Not required.
6. Outlet Connection: Spigot.
7. Closure: Plastic plug.
8. Adjustable Housing Material: Cast iron with threads.
9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy
10. Frame and Cover Shape: Round in concrete floors, square in tiled floors.
11. Top Loading Classification: Heavy Duty.
12. Riser: ASTM A74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Standard: ASME A112.36.2M. Include wall access.
2. Size: Same as connected drainage piping.
3. Body: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure: Countersunk, plastic plug.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
6. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

2.3 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Standard: ASME A112.6.3.
2. Pattern: Floor drain.
3. Body Material: Gray iron.
4. Seepage Flange: Required for slabs above grade.
5. Anchor Flange: Required for slabs on grade.
6. Clamping Device: Required, where floor has waterproofing membrane.
7. Outlet: Bottom or Side as required.
8. Backwater Valve: Not required.
9. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel when located in equipment rooms.
10. Sediment Bucket: Slotted type when located in equipment rooms.
11. Top or Strainer Material: Gray iron in unfinished floors, Nickel bronze in finished floors.
12. Top of Body and Strainer Finish: Nickel bronze in unfinished floors, polished bronze in finished floors.
13. Top Shape: Round in concrete floors, Square in tiled floors.
14. Top Loading Classification: Extra heavy-duty in areas with vehicle traffic, heavy duty in equipment rooms, light duty in finished areas.
15. Funnel: Required, where indicated on drawings.
16. Trap Material: Cast iron or copper to match adjacent piping.
17. Trap Pattern: Standard P-trap unless noted otherwise.
18. Trap Features: Trap-seal primer valve connection and cleanout where trap primers are indicated.

B. Stainless-Steel Floor Drains for use with Stainless-Steel Waste Piping:

1. Pattern: Floor drain.
2. Body Material: Type 304 stainless steel.
3. Seepage Flange: Required for slabs above grade.
4. Anchor Flange: Required for slabs on grade.

5. Clamping Device: Required, where floor has waterproofing membrane.
6. Outlet: Bottom or Side as required.
7. Backwater Valve: Not required.
8. Top or Strainer Material: Type 304 stainless steel.
9. Top of Body and Strainer Finish: Type 304 stainless steel.
10. Top Shape: Round in concrete floors, Square in tiled floors.
11. Top Loading Classification: Extra heavy-duty in areas with vehicle traffic, heavy duty in equipment rooms, light duty in finished areas.
12. Funnel: Required, where indicated on drawings.
13. Trap Material: Type 304 stainless steel to match adjacent piping.
14. Trap Pattern: Standard P-trap unless noted otherwise.
15. Trap Features: Trap-seal primer valve drain connection and cleanout where trap primers are indicated.

2.4 FLOOR SINKS

A. Cast-Iron Floor Sinks:

1. Standard: ASME A48-83.
2. Pattern: Floor sink.
3. Body Material: Gray iron.
4. Seepage Flange: Required for slabs above grade.
5. Anchor Flange: Required for slabs on grade.
6. Clamping Device: Required, where floor has waterproofing membrane.
7. Outlet: Bottom.
8. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel.
9. Sediment Bucket: Aluminum slotted type when located in kitchen area
10. Dome Strainer: Anti-splash with acid-resistant enamel coating for non-kitchen areas.
11. Top or Grate Material: Acid-resistant enamel, fully coated.
12. Grate: Full, three-quarters, or half as required for application.
13. Top Shape and Size: Square, 12" x 12" unless noted otherwise.
14. Basin Depth: 8 inches unless noted otherwise.
15. Funnel: Required, where indicated on drawings.
16. Trap Material: Cast iron or copper to match adjacent piping.
17. Trap Pattern: Standard P-trap unless noted otherwise.
18. Trap Features: Trap-seal primer valve drain connection where trap primers are indicated.

B. Stainless-Steel Floor Sinks for use with Stainless-Steel Waste Piping:

1. Pattern: Floor sink.
2. Body Material: Stainless steel.
3. Seepage Flange: Required for slabs above grade.
4. Anchor Flange: Required for slabs on grade.
5. Clamping Device: Required, where floor has waterproofing membrane.
6. Outlet: Bottom.
7. Sediment Bucket: Stainless-steel slotted type when located in kitchen area.
8. Dome Strainer: Anti-splash for non-kitchen areas.
9. Top or Grate Material: Type 304 stainless steel.
10. Grate: Full, three-quarters, or half as required for application.
11. Top Shape and Size: Square, 12" x 12" unless noted otherwise.
12. Basin Depth: Minimum of 8 inches unless noted otherwise.
13. Funnel: Required, where indicated on drawings.
14. Trap Material: Type 304 stainless steel to match adjacent piping.
15. Trap Pattern: Standard P-trap unless noted otherwise.
16. Trap Features: Trap-seal primer valve drain connection where trap primers are indicated.

2.5 ROOF FLASHING ASSEMBLIES

- A. Description: Manufactured assembly made of 4.0-lb./sq.ft., 0.0625-inch-thick, lead flashing collar and skirt extending at least 6 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

1. Open-Top Vent Cap: Without cap.

2.6 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

- A. Open Drains:

1. Description: Shop or field fabricate from ASTM A74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C564, rubber gaskets.
2. Size: Same as connected waste piping.

- B. 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.

- C. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

- D. Barrier-Type Trap Sealer:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. IPS Corporation.
 - b. Jay R. Smith Manufacturing Co.
 - c. MIFAB, Inc.
 - d. Precision Plumbing Products.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. RectorSeal.
2. Description: Device that is installed at the drain body outlet to prevent sewer gases from escaping the waste piping into the building while allowing water and other materials to flow into the waste system. User replaceable from above.
3. Materials: Flexible elastomeric material such as PVC, EPDM, etc.
4. Conformance: ASSE 1072 or other standard acceptable to the Authority Having Jurisdiction.

- E. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.

2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

F. 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.

G. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

2.7 FLASHING MATERIALS

A. Lead Sheet: ASTM B749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb./sq.ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb./sq.ft., 0.0469-inch thickness.
3. Burning: 6-lb./sq.ft., 0.0938-inch thickness.

B. Fasteners: Metal compatible with material and substrate being fastened.

C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

D. Solder: ASTM B32, lead-free alloy.

E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. Install a two-way cleanout at the waste piping exit of the building.
- E. Extend surface cleanouts up to grade.
 - 1. For cleanouts terminating in paved or other finished surfaces, install cleanout deck plate with top flush with finished surface.
 - 2. For cleanouts terminating in landscaping or other unfinished surface, install cleanout deck plate flush with top of (and centered in) minimum 12" x 16" x 4" concrete pad. Pad to be flush with adjacent surfaces.
- F. 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% slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1% slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1% 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.
- G. Install floor sinks where indicated on drawings. Set grates of sinks flush with finished floor, unless otherwise indicated.
 - 1. Position floor sinks for easy access and maintenance.
 - 2. Install floor-sink flashing collar or flange so no leakage occurs between sink and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 3. Install individual traps for floor sinks connected to sanitary building drain, unless otherwise indicated.
- H. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- I. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- J. Assemble open drain fittings and install with top of hub 2 inches above floor.
- K. Install deep-seal traps on floor drains and other waste outlets where indicated.
- L. Install barrier-type trap sealers on all floor sinks and floor drains in accordance with the manufacturer's installation instructions unless indicated otherwise on the drawings.

- M. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 - 2. Size: Same as floor drain inlet.
- N. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- O. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- P. Install vent caps on each vent pipe passing through roof.
- Q. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

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 specifications.
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.4 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

Edition 0308-0319

SECTION 22 33 00

ELECTRIC DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes:

1. Commercial, electric, storage, domestic-water heaters.
2. Domestic-water heater accessories.

1.2 SUBMITTALS

A. Product Data: Provide manufacturer's product data for each unit indicated on the drawings. Data to be specific to the equipment proposed for the project with all options and accessories indicated. Include the following as a minimum:

1. Manufacturer and model number.
2. Rated capacity based on scheduled conditions.
3. Equipment dimensions.
4. Required clearances.
5. Electrical Data:
 - a. Voltage/Phase/Hz.
 - b. Electrical service point(s) of connection.
6. Materials of construction.
7. Accessories and options.
8. Controls.

B. Domestic-Water Heater Labeling: Certified and labeled by the testing agency acceptable to the Authorities Having Jurisdiction.

C. Operation and maintenance data.

D. Warranty: Sample of special warranty.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/ IESNA 90.1.

C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, Drinking Water System Components - Health Effects.

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Warranty Periods: From date of Substantial Completion.
 - a. Commercial, Electric, Storage, Domestic-Water Heaters:
 - 1) Storage Tank: 3 years.
 - 2) Controls and Other Components: 3 years.
 - b. Residential, Electric, Storage, Domestic-Water Heaters:
 - 1) Storage Tank: 6 years.
 - 2) Controls and Other Components: 3 years.
 - c. Electric, Tankless, Domestic-Water Heaters: 5 years.
 - d. Compression Tanks: 5 years.

PART 2 - PRODUCTS

2.1 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. A.O. Smith Corporation.
 2. Bradford White Corporation.
 3. Lochinvar Corporation.
 4. PVI Industries, LLC.
 5. Rheem Manufacturing Company.
- B. Commercial, Electric, Storage, Domestic-Water Heaters:
1. Standard: UL 174 or UL 1453.
 2. Storage-Tank Construction: Steel vertical arrangement. Comply with ASME-code for tanks larger than 120 gallons or heater inputs larger than 12 kW.
 - a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.
 - 1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
 - 2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
 - b. Pressure Rating: 150 psig.
 - c. Interior Finish: Glass, enamel or similar baked-on finish complying with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.

3. Factory-Installed Storage-Tank Appurtenances:

- a. Anode Rod: Replaceable magnesium.
- b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
- c. Drain Valve: Corrosion-resistant complying with ASSE 1005.
- d. Insulation: Comply with ASHRAE/IESNA 90.1.
- e. Jacket: Steel with enameled finish.
- f. Heating Elements: Electric, screw-in or bolt-on immersion type wired for simultaneous operation unless noted otherwise.
- g. Temperature Control: Adjustable thermostat.
- h. Safety Controls: High-temperature-limit cutoff devices or systems.
- i. Relief Valves: ASME rated and stamped for combination temperature-and-pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

4. Special Requirements: NSF 5 construction.

2.2 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Compression Tanks:

- 1. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm.
- 2. Construction:
 - a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
 - b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed.
- 3. Capacity and Characteristics:
 - a. Working-Pressure Rating: 125 psig.
 - b. Air Precharge Pressure: 12 psig.

- B. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads.
- C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1.
- D. Heat-Trap Fittings: ASHRAE 90.2.
- E. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.
- F. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test commercial domestic-water heaters to minimum of 1.5 times pressure rating before shipment.
- C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 specifications for retesting and reinspecting requirements and for requirements for correcting the work.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters in drain pan on strut stand to support bottom of heater minimum 6 inches above finished floor. Comply with requirements for supports specified in Hangers and Supports for Plumbing Piping and Equipment.
 - 1. Exception: Omit strut stands for commercial, electric, domestic-water heaters if installation on bracket, suspended platform, concrete pad, or directly on floor is indicated.
 - 2. Maintain manufacturer's recommended clearances.
 - 3. Arrange units so controls and devices that require servicing are accessible.
 - 4. For supported equipment, install epoxy-coated anchor bolts that anchor stand to structural concrete floor.
 - 5. For units installed on concrete bases:
 - a. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - b. Install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - c. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - d. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Anchor domestic-water heaters to substrate.
- B. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
 - 1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Specification Section 22 05 23, General Duty Valves for Plumbing Piping.
- C. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor sink, mop sink, or to exterior with downturned elbow at 6 inches above grade.

- D. Install water-heater drain-pan drain piping to nearest floor drain, floor sink or mop sink. Coordinate mounting height of water heater to allow for sloping of drain piping from drain pan to receptor.
- E. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Specification Section 22 05 19, Meters and Gages for Plumbing Piping.
- F. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps. Piping-type heat traps shall consist of a minimum 12-inch vertical drop or 360-degree loop of piping.
- G. Flush and fill electric, domestic-water heaters with water. Vent trapped air from water heater.
- H. Charge domestic-water compression tanks with air. Set pressure equal to incoming water pressure. Set pressure with one hot water tap flowing.

3.2 CONNECTIONS

- A. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Specification Section 22 05 53, Identification for Plumbing Piping and Equipment.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 - 2. Leak Test: After installation, charge system 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 operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 specifications for retesting and reinspecting requirements and for requirements for correcting the work.
- C. Prepare test and inspection reports.

END OF SECTION

Edition 0308-0419

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SECTION 22 40 00

PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes standard plumbing fixtures and accessories.

1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. FRP: Fiberglass-reinforced plastic.
- D. PMMA: Polymethyl methacrylate (acrylic) plastic.
- E. PVC: Polyvinyl chloride plastic.
- F. Solid Surface: Non-porous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated, include manufacturer, model number, options and accessories. Label each data submittal with fixture designation shown on drawings.
- B. Warranty information.
- C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to the Authorities Having Jurisdiction, and marked for intended use.
- B. Regulatory Requirements:
 - 1. 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.
 - 2. Comply with requirements in Public Law 102-486, Energy Policy Act, about water flow and consumption rates for plumbing fixtures.
- C. NSF Standard: Comply with NSF 61, Drinking Water System Components--Health Effects, for fixture materials that will be in contact with potable water.

- D. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible and of the same manufacturer for all like items.
- E. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 2. Plastic Laundry Trays: ANSI Z124.6.
 3. Plastic Shower Enclosures: ANSI Z124.2.
 4. Plastic Sinks: ANSI Z124.6.
 5. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
 6. Slip-Resistant Bathing Surfaces: ASTM F462.
 7. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
 8. Stainless-Steel Residential Sinks: ASME A112.19.3.
 9. Vitreous-China Fixtures: ASME A112.19.2M.
 10. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
 11. Water-Closet, Flushometer Tank Trim: ASSE 1037.
- F. 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. Components shall be lead-free as defined by the Safe Drinking Water Act Amendments of 1986 and the Lead Contamination Control Act of 1988.
- G. 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 F409.
 6. Brass Waste Fittings: ASME A112.18.2.
 7. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
- H. 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.
 3. Flexible Water Connectors: ASME A112.18.6.
 4. Grab Bars: ASTM F446.
 5. Hose-Coupling Threads: ASME B1.20.7.

6. Hot-Water Dispensers: ASSE 1023 and UL 499.
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 & Drain Protective Shielding Guards: ICC A117.1, ASTM E84-07.

PART 2 - PRODUCTS

2.1 LAVATORY AND SINK FAUCETS

A. Standard Lavatory and Sink Faucets:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated or a comparable product by one of the following:
 - a. American Standard Brands.
 - b. Bradley Corporation.
 - c. CHG Component Hardware Group.
 - d. Chicago Faucets.
 - e. Delany Products.
 - f. Delta Commercial Faucet Company.
 - g. Elkay Manufacturing Co.
 - h. Grohe America, Inc.
 - i. Just Manufacturing Company.
 - j. Kohler Co.
 - k. Moen, Inc.
 - l. Powers; a Watts Water Technologies Co.
 - m. Speakman Company.
 - n. T & S Brass and Bronze Works, Inc.
 - o. Zurn Plumbing Products Group; Commercial Brass Operation.

B. Metering Lavatory Faucets:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated or a comparable product by one of the following:
 - a. American Standard Brands.
 - b. CHG Component Hardware Group.
 - c. Chicago Faucets.
 - d. Moen, Inc.
 - e. Powers; a Watts Water Technologies Co.
 - f. Sloan Valve Company.
 - g. Symmons Industries, Inc.
 - h. Zurn Plumbing Products Group; Commercial Brass Operation.

2.2 FLUSH VALVES FOR URINALS AND WATER CLOSETS

- #### **A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated or a comparable product by one of the following:**
1. American Standard Brands.
 2. Delany Products.
 3. Moen, Inc.
 4. Sloan Valve Company.

5. TOTO USA, Inc.
6. Zurn Plumbing Products Group; Commercial Brass Operation.

2.3 TOILET SEATS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated or a comparable product by one of the following:
1. American Standard Brands.
 2. Bemis Manufacturing Company.
 3. Church Seats.
 4. Kohler Co.
 5. Olsonite Corp.
 6. Sanderson Plumbing Products, Inc.; Beneke Division.
 7. Sperzel.
 8. Zurn Plumbing Products Group; Commercial Brass Operation.

2.4 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. McGuire Manufacturing Co., Inc.
 - b. Plumberex Specialty Products Inc.
 - c. TRUEBRO, Inc.
 - d. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.
 2. Description: Manufactured plastic wraps for covering plumbing fixture hot-water, cold-water, and tempered-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements. Product shall meet ADA and ICC/ANSI A117.1. Insulation material shall comply with ASTM E84-07/UL 723 Class A and shall be listed and meet UPC/IAPMO.

2.5 FIXTURE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Jay R. Smith Manufacturing Co.
 2. MIFAB Manufacturing Inc.
 3. Sun Drainage Products.
 4. Tyler Pipe; Wade Division.
 5. Watts Drainage Products; a Division of Watts Water Technologies.
 6. Zurn Plumbing Products Group; Specification Drainage Operation.

2.6 DISHWASHER AIR-GAP FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Dearborn Brass; a Division of Moen, Inc.
 2. Geberit Manufacturing, Inc.
 3. Sioux Chief Manufacturing Company, Inc.

4. Watts Brass & Tubular; a Division of Watts Water Technologies.

2.7 DISPOSERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated or a comparable product by one of the following:
 1. In-Sink-Erator; a Division of Emerson Electric Co.
 2. KitchenAid.
 3. Maytag Co.

2.8 LAVATORIES, WATER CLOSETS, AND URINALS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated or a comparable product by **one of** the following:
 1. American Standard Brands.
 2. Coroma.
 3. Kohler Co.
 4. Waterless Company, Inc.
 5. Zurn Plumbing Products Group.

2.9 STAINLESS-STEEL SINKS

- A. Kitchen Sinks:
 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated or a comparable product by one of the following:
 - a. American Standard Brands.
 - b. Elkay Manufacturing Company.
 - c. Just Manufacturing Company.
 - d. Moen, Inc.

2.10 SERVICE SINKS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated or a comparable product by one of the following:
 1. American Standard Companies, Inc.
 2. Fiat Products.
 3. Just Manufacturing Company.
 4. Kohler Co.

2.11 MOP SINKS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated or a comparable product by one of the following:
 1. American Standard Brands.
 2. Fiat Products.
 3. Florestone Inc.
 4. Just Manufacturing Company.
 5. Zurn Plumbing Products Group.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturer's 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 back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-mounting fixtures with tubular waste piping attached to supports.
- F. Install fixtures level and plumb according to roughing-in drawings.
- G. 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.
- H. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- I. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- J. Install flush valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- K. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- L. Install toilet seats on water closets.
- M. Install faucet-spout fittings with specified flow rates and patterns. If faucets are not available with required rates and patterns, include adapters as required.
- N. Install gooseneck faucets to spill into sink or lavatory basin.
- O. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- P. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- Q. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

- R. Install disposer in outlet of each sink indicated to have disposer.
- S. Install dishwasher air-gap fitting at each sink indicated to have air-gap fitting. Connect inlet hose to dishwasher and outlet hose to disposer.
- T. Install escutcheons at piping wall and 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 Specification Section 22 05 18, Escutcheons for Plumbing Piping.
- U. 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 specifications.
- V. Install protective shielding guards per the manufacturer's written instructions to cover all exposed piping and valves below handicap accessible sinks and lavatories.

3.2 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

3.3 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. Flush and replace all lavatory and sink aerators, and shower heads after water systems are pressurized, cleaned, and sanitized.
- E. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- F. Set temperature limiting devices to a maximum of 120°F unless noted otherwise on the drawings.
- G. Install fresh batteries in sensor-operated mechanisms.

3.4 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 the Owner.

END OF SECTION

Edition 0308-0419

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SECTION 22 47 00

DRINKING FOUNTAINS & WATER COOLERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes drinking fountains and water coolers.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated, include manufacturer, model number, options, and accessories.
- B. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to the Authorities Having Jurisdiction (AHJ), and marked for intended use.
- B. 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 fixtures for people with disabilities.
- C. NSF Standard: Comply with NSF 61, Drinking Water System Components--Health Effects, for fixture materials that will be in contact with potable water.
- D. ARI Standard: Comply with ARI's Directory of Certified Drinking Water Coolers for style classifications.
- E. ARI Standard: Comply with ARI 1010, Self-Contained, Mechanically Refrigerated Drinking-Water Coolers, for water coolers and with ARI's Directory of Certified Drinking Water Coolers for type and style classifications.
- F. ASHRAE Standard: Comply with ASHRAE 34, Designation and Safety Classification of Refrigerants for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant unless otherwise indicated.

PART 2 - PRODUCTS

2.1 DRINKING FOUNTAINS AND WATER COOLERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated or a comparable product by one of the following:
 - 1. Acorn Engineering Company.
 - 2. Elkay Manufacturing.
 - 3. Halsey Taylor.
 - 4. Oasis Corporation.

5. Sunroc Corp.

2.2 FIXTURE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Jay R. Smith Manufacturing Co.
 2. Josam Co.
 3. MIFAB Manufacturing, Inc.
 4. Tyler Pipe; Wade Division.
 5. Watts Drainage Products Inc.; a Division of Watts Industries, Inc.
 6. Zurn Plumbing Products Group; Specification Drainage Operation.
- B. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.
 1. Type I: Hanger-type carrier with two vertical uprights.
 2. Type II: Bi-level, hanger-type carrier with three vertical uprights.
 3. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.
- B. Set freestanding and pedestal drinking fountains on floor or concrete pad.
- C. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view.

3.2 INSTALLATION

- A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.
- B. Install fixtures level and plumb. For fixtures indicated for children, install at height required by the AHJ.
- C. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball valve unless otherwise indicated. Install valves in locations where they can be easily reached for operation. Valves are specified in Specification Section 22 05 23, General Duty Valves for Plumbing Piping.
- D. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- E. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Specification Section 22 05 18, Escutcheons for Plumbing Piping.

- F. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 specifications.

3.3 CONNECTIONS

- A. Connect fixtures with water supplies, traps, and risers, and with soil, waste, and vent piping. Use size fittings required to match fixtures.

3.4 FIELD QUALITY CONTROL

- A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.
 - 1. Remove and replace malfunctioning units and retest as specified above.
 - 2. Report test results in writing.

3.5 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust water cooler temperature settings.

END OF SECTION

Edition 0308-1115

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DIVISION 23

HEATING, VENTILATING & AIR CONDITIONING

23 05 00	Common Work Results for HVAC
23 05 00	General Provisions
23 05 01	Demonstration & Training for HVAC Systems & Components
23 05 13	Common Motor Requirements for HVAC Equipment
23 05 17	Sleeves & Sleeve Seals for HVAC Piping
23 05 18	Escutcheons for HVAC Piping
23 05 20	Electrical & Control Wiring for Mechanical Systems
23 05 29	Hangers & Supports for HVAC Piping & Equipment
23 05 48.13	Vibration Controls for HVAC Piping & Equipment
23 05 53	Identification for HVAC Piping & Equipment
23 05 93	Testing, Adjusting & Balancing for HVAC
23 07 00	HVAC Insulation
23 07 13	Duct Insulation
23 07 19	HVAC Piping Insulation
23 08 00	Commissioning of HVAC
23 08 00	Commissioning of HVAC
23 23 00	Refrigerant Piping
23 23 00	Refrigerant Piping
23 31 00	HVAC Ducts & Casings
23 31 13	Metal Ducts
23 33 00	Air Duct Accessories
23 33 00	Air Duct Accessories
23 34 00	HVAC Fans
23 34 23	HVAC Power Ventilators
23 37 00	Air Outlets & Inlets
23 37 13	Diffusers, Registers & Grilles
23 81 00	Decentralized Unitary HVAC Equipment
23 81 26	Split-System Air Conditioners

END OF INDEX



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SECTION 23 05 00

GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SCOPE

- A. Provisions of this section apply to all work specified in all sections under Division 23.
- B. In addition, work in Division 23 is governed by the provisions of the Bidding Requirements, Contract Forms, General Conditions, and all sections in Division 01 specifications.
- C. The Contract Documents do not specify exact installation means and methods or Contractor safety procedures. Installation means and methods and safety procedures are the responsibility of the Contractor. No instruction or statement made on the Contract Documents shall be interpreted to shift this responsibility away from the Contractor.
- D. These specifications contain statements which are more definitive or more restrictive than those contained in the General Conditions. Where these statements occur, they shall take precedence over the General Conditions.

1.2 DEFINITIONS

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

1.3 EXAMINATION OF PREMISES

- A. Visit the site, verify all measurements and project conditions, and pay all costs necessary to perform the work.

1.4 MECHANICAL CONTRACTOR

- A. The Mechanical Contractor shall hold a current contracting license that has been valid for a minimum of 2 years in the State of Arizona as a mechanical contractor.

1.5 REGULATIONS, PERMITS, FEES, CHARGES, INSPECTIONS

- A. Regulations: Comply with all applicable codes, rules and regulations.
- B. Fees and Permits: Pay all connection, installation, use, disposal, development, etc., fees and/or charges. Obtain and pay for all required permits and licenses. Refer to Division 01 specifications.
- C. Inspections: All work must be inspected and approved by the local authorities. Prior to final approval, furnish the Architect with certificates of inspections and approvals by the local authorities in accordance with Division 01 specifications.

1.6 DRAWINGS AND SPECIFICATIONS

- A. Refer to Division 01 specifications for additional information on submittals and shop drawings.
- B. If a conflict exists on the drawings or between the drawings and specifications, promptly notify the Architect.

1.7 SUBMITTALS

- A. Submittals are for information and coordination only. The Engineer will diligently review the submittals and attempt to verify compliance with the project requirements. Such review, however, does not constitute approval or disapproval or obligation to comply with all project requirements. The submittals are not to be construed to be contract documents. Any failure by the Engineer to note a point of non-compliance shall not be construed to be acceptance or approval of the discrepancy.
- B. Product Information Sheets: Provide project-specific manufacturer's literature which includes the information required by the Product Data paragraph of the applicable specification section. Where Product Information Sheets show multiple models or options, clearly mark the model and options to be provided.
- C. Assembly: Assemble all required submittal information for each specification section and submit in Portable Document Format (PDF).
 - 1. Assemble PDF submittals in one PDF file for each division. Separate and order sections within each file by corresponding specification number. Provide bookmarks at the first page of each section and label each bookmark with the specification number and name to allow for easy navigation of the submittal.
 - 2. Partial submittals and submittals that are not project specific will be returned without review. Submittals for Building Automation System may be submitted separately.
- D. Identification and Information:
 - 1. Name the PDF file with the project name, division number and sequential submittal number (i.e., the first submittal shall be No. 1; the second submittal shall be No. 2).
 - 2. Provide a cover sheet at the front of each submittal with the following information:
 - a. Project name.
 - b. Date.
 - c. Name of Engineer.
 - d. Name of Contractor.
 - e. Name of subcontractor.

3. Provide a cover sheet at the front of each submittal section with the following information:

- a. Name of supplier.
- b. Name of manufacturer.
- c. Number and title of appropriate specification section.
- d. Drawing number and detail references, as appropriate.
- e. Other necessary identification.

E. Options:

1. Identify options requiring selection by the Engineer.
2. Identify options included with submittal item.

F. Deviations: Identify deviations from the Contract Documents on submittals.

G. Furnished by Others: This project is to provide a complete and functional system. Where material or labor is indicated in the submittal to be provided "by others" clearly indicated who is providing those items and include information to indicate proper coordination.

1.8 MATERIAL SAFETY DATA SHEETS

A. Provide current, Material Safety Data Sheets (MSDS), for all hazardous materials that are proposed for use at the project site.

1. Provide one complete set to the Owner for review and approval a minimum of 1 week prior to the delivery of any hazardous materials to the site.
2. Maintain a second complete set at the project location, readily accessible by both the Owner's personnel and the Contractor's personnel.

1.9 REQUEST FOR INFORMATION

A. Request for Information (RFI):

1. A document submitted by the Contractor requesting clarification of a portion of the Contract Documents, hereinafter referred to as RFI.
2. A properly prepared request for information shall include a detailed written statement of the clarification, apparent conflict, or information requested that indicates the specific drawings or specification in need of clarification and the nature of the clarification requested.
 - a. Drawings shall be identified by drawing number and location on the drawing sheet.
 - b. Specifications shall be identified by section number, page, and paragraph.
3. Include a proposed solution, where appropriate, based upon the field conditions and best knowledge of the Contractor.

B. Improper or Frivolous RFIs: RFIs which are not properly prepared or that request information which is clearly shown in the Contract Documents will be returned unanswered. Processing time for multiple submissions of improper or frivolous RFIs will be billed at the Engineer's standard hourly rate to the Owner who may deduct an equal amount from the monies due the Contractor.

1.10 AS-BUILT DRAWINGS

A. As-Built Drawings: Maintain one set of marked-up paper copies of the Contract Drawings.

1. Preparation: Mark As-Built Drawings to show the actual installation where installation varies from that shown originally. Include all equipment, and underground and overhead piping.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Include dimensions both horizontally and vertically to permanent points of reference, accurate within 6 inches. Include descriptors such as "below slab," "above ceiling," etc.
 - c. Record data daily or as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 2. Mark the As-Built Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of As-Built Drawings.
 3. Mark As-Built Drawings with erasable, red colored pencil, or in a digital PDF format using an editor program such as Bluebeam, Adobe Acrobat Professional, or similar. Use other colors to distinguish between changes for different categories of the work at the same location.
 4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
 5. Update the As-Built Drawings weekly or daily as appropriate for the project size.
- B. Format: Identify and date each As-Built Drawing; include the designation "PROJECT AS-BUILT DRAWING" in a prominent location.
1. Organize newly-prepared As-Built Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Identification, as follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT AS-BUILT DRAWINGS."
 - d. Name of Engineer.
 - e. Name of Contractor.
 3. Remove or obscure the Engineer's seal and signature from As-Built Drawings.

1.11 OPERATION AND MAINTENANCE MANUAL

- A. Prior to completion of the project, compile a complete Equipment, Operation and Maintenance Manual for all equipment supplied under Division 23.
- B. Schedule:
1. Submit a preliminary copy of the manual not less than 30 days prior to Substantial Completion for review and comment.
 2. Submit the final version of the manual not more than 4 weeks after Substantial Completion of the project.
- C. Format: Submit manuals in both of the following formats:
1. PDF Electronic Files: Assemble each manual into a single master directory with sub-directories for the individual PDF files for each system and piece of equipment. Provide a table of contents file with hyperlinks to each of the individual PDF files within the sub-directories. Submit on digital media acceptable to the Engineer.

- a. Name each directory, sub-directory, and document file with applicable item name.
 - b. Enable reviewer comments on draft submittals.
2. Paper Copies: Assemble paper copies in 3-ring binders. Separate and order systems and equipment within each binder. Provide labeled tabs at each section with a table of contents at the front of the binder. The table of contents shall indicate the tab number and the information contained at that tab. Enclose title pages and directories in clear plastic sleeves.
- D. Provide Operation and Maintenance Manuals for all systems, subsystems, and equipment that require operation and regular maintenance, or have replaceable parts.
- E. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, product data, manufacturer's 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. In addition to requirements in this section, include operation and maintenance data required in individual specification sections.
- F. 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.
- G. Product Data: Include the following information:
 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Approved submittals.
 3. Include the following if not shown on approved submittals:
 - a. Product name and model number. Use designations for products indicated on Contract Documents.
 - b. Manufacturer's name.
 - c. Equipment identification with serial number of each component.
 - d. Equipment function.
 - e. Operating characteristics.
 - f. Limiting conditions.
 - g. Performance curves.
 - h. Engineering data and tests.
- H. Operating Procedures: Include the following, as applicable:
 1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures. Including precautions against improper use.
 10. Operating logs.

- I. Wiring Diagrams: Diagram of factory-installed wiring including any options as well as any field modifications.
- J. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- K. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification. Include valve locations and designations.
- L. Manufacturer's Maintenance Documentation: Manufacturer's 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.
- M. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.
 - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - 5. Aligning, adjusting, and checking instructions.
 - 6. Demonstration and training video recording, if available.
- N. 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.
- O. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturer's maintenance documentation and local sources of maintenance materials and related services.
- P. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- Q. Licenses: Include copies of any licenses with requirements including inspection and renewal dates.
- R. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
- S. Test and Balance Report: Include a final approved copy of the Test and Balance Report.

1.12 WORK AND MATERIALS

- A. Unless otherwise specified, all materials must be new and of the quality specified. The workmanship shall be of a quality that is acceptable to the Architect, Engineer, and Owner, and is equal to the standards of the trades. The Contractor must staff the project with sufficient skilled workmen, including a fully qualified construction superintendent, to complete the work in the time allotted. The superintendent must be qualified to supervise all of the work in his work category.

- B. Uniformity: Unless otherwise specified, provide all equipment and products of the same type or classification by the same manufacturer.

1.13 APPROVALS OF MATERIALS AND EQUIPMENT

- A. Refer to Division 01 specifications for description of material and equipment for prior approvals and substitutions.

1.14 COOPERATIVE WORK

- A. Correct without charge any work requiring alteration due to lack of proper supervision or failure to make proper provision in time. Correct without charge any damage to adjacent work caused by the alteration. Refer to Division 01 specifications for additional requirements.
- B. Cooperative work Includes:
 - 1. General supervision and responsibility for proper location, rough-in and size of work related to Division 23 but provided under other divisions of these specifications.
 - 2. Installation of sleeves, inserts and anchor bolts for work under sections in Division 23.
 - 3. Sealing of penetrations through fire and smoke barriers caused by work installed as part of Division 23.

1.15 EXISTING MATERIALS AND EQUIPMENT

- A. Disposition: With the exception of items that are to be reused or retained by the Owner, all other materials indicated to be removed shall be removed and legally disposed of by the Contractor. Items that are indicated to be retained or returned to the Owner shall be delivered to a storage area designated by the Owner.
- B. Unused Materials: All unused piping, ductwork, controls and miscellaneous materials shall be removed by the Contractor except where located within walls, below or above existing construction which is not being altered and would require removal and replacement of this existing construction. All visible piping, ductwork, etc., shall be removed and sealed or capped within wall, below floor, or above ceiling unless noted otherwise.
- C. Exterior Services: The Contractor shall be responsible for maintaining mechanical and control service to the existing building during the construction period. Existing services are to be retained until such a time that the new services, if any, are completely installed and ready for use. Scheduling of service interruptions is to be coordinated with the Architect and Owner.
- D. Disconnect, demolish, and remove mechanical systems, equipment, and components that are indicated to be removed.
 - 1. Piping to be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with the same or compatible piping material. Patch insulation, as required, to match adjacent areas.
 - 2. Piping to be Abandoned In Place: Drain piping and cap or plug piping with the same or compatible piping material.
 - 3. Ducts to be Removed: Remove portion of ducts indicated to be removed and cap remaining ducts with the same or compatible ductwork material. Patch insulation, as required, to match adjacent areas.
 - 4. Ducts to be Abandoned In Place: Cap ducts with the same or compatible ductwork material.
 - 5. Equipment to be Removed: Disconnect and cap services and remove equipment.

6. Equipment to be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 7. Equipment to be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to the Owner.
- E. Continuity of Services in Existing Building: The Contractor shall permanently reroute existing mechanical and control services or provide temporary connection as required to maintain service to existing equipment and systems in building which are to remain in service.
- F. Rerouting and Relocation of Existing Mechanical Equipment and Services in Existing Building:
1. General: The Contractor shall reroute, relocate all existing materials which are in conflict with the building alterations and which are required to be maintained in use.
 2. Existing Piping and Ductwork: Where applicable, existing material may be reused in their original location unless otherwise indicated.
- G. Testing: All existing services affected by the new construction and which are modified, reused or are to remain in operation shall be returned to their original condition. The existing services shall be tested as new, as described in other sections of these specifications. If for any reason these requirements cannot be met, the Contractor shall immediately notify the Architect.
- 1.16 CONSTRUCTION FACILITIES
- A. General: Under this division of the specifications, execute all work in a manner to provide safe and lawful ingress and egress to the Owner's establishment and such facilities shall be kept clear of materials or equipment. Refer to Division 01 specifications for additional requirements.
- B. Furnish and maintain from the beginning to the completion of all work all lawful and necessary security, guards, railings, fences, canopies, lights, fire protection, and warning signs. Take all necessary precautions required by city and state laws to avoid injury or damage to any and all persons and property.
- 1.17 GUARANTEE
- A. Guarantee all material, equipment, installation and workmanship for all sections under Division 23 in writing to be free from defects of material and workmanship for 1 year from date of final acceptance as outlined in Division 01 specifications. Equipment warranties shall be a minimum of 1 year from date of Substantial Completion or as specified elsewhere. Replace without charge any material or equipment proving defective during this period. The guarantee shall include performance of the equipment under all conditions of load, installing any additional items of control and/or protective devices as required and the replacing of any refrigerant lost.
- 1.18 MECHANICAL WIRING
- A. Provide all temperature control wiring, interlock wiring, and equipment control wiring for the equipment that is to be provided under Division 23 unless wiring is specifically shown on the electrical drawings.
- B. The following schedule is intended to summarize the division of work and material responsibilities between the Mechanical Contractor, Controls Contractor and Electrical Contractor.

Item	Furn. By	Set By	Power Wiring	Control Wiring
Equipment Motors	MC	MC	EC	--
Motor Control Center	EC	EC	EC	CC
Motor Starters, Controllers, Contactors & Overload Heaters	MC*	EC**	EC	CC
Fused & Non-Fused Disconnect Switches	EC**	EC**	EC	--
Manual Operating Switches, Multi-Speed Switches, Pushbutton Stations & Pilot Lights	CC	CC	CC	CC
Control Relays & Transformers	CC	CC	CC	CC
Line Voltage Thermostats & Time Switches***	MC	MC	EC	EC
Low-Voltage Thermostats	MC	MC	-	MC
Temperature Control Panels	MC	MC	EC	CC
Smoke Detectors (Duct Mounted)	EC	MC	EC	MC or CC
Motor & Solenoid Valves, Damper Motors, PE & EP Switches	CC	MC	CC	CC
Water Treatment Equipment	MC	MC	EC	CC
MC = Mechanical Contractor CC = Controls Contractor EC = Electrical Contractor *Except where such devices are located in MCCs. **Unless required by these specifications to be provided as part of a factory- furnished assembly (i.e., fan coils, air handlers, chillers, etc.). ***Motor-drive units which are controlled from line voltage automatic controls such as line voltage thermostats, float switches or time switches which conduct full load current of the motor shall be wired for both power and control circuit under the electrical contract.				

PART 2 - PRODUCTS

2.1 MACHINERY DRIVES

- A. Unless otherwise specified in Division 23 equipment sections, use V-belts designed for 150% of capacity for all belt drives. For multiple belt drives, use matched sets, so marked at the factory.
- B. On drives with not more than two belts, provide adjustable pitch motor sheaves with the midpoint of the adjustment range equal to that required to achieve the specified fan capacity.
- C. On motors with drives with more than two belts, furnish non-adjustable sheaves, providing the specified fan capacity.

2.2 MACHINERY ACCESSORIES

- A. Guards: Provide totally enclosed OSHA-type belt guards for all rotating equipment. Design guards to be readily removable for access to belt drives.

2.3 GROUT

- A. Description: ASTM C1107, Grade B, non-shrink and non-metallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, non-staining, non-corrosive, non-gaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5,000-psi, 28-day compressive strength.
- B. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SUBMITTALS

- A. Prepare submittals as directed for review by the Contractor, Owner, Architect, and Engineer.
- B. Submit one copy of PDF submittals via email, project website or other electronic media.

3.2 REFRIGERANT HANDLING AND DOCUMENTATION

- A. Refrigerant Handling: Handle, contain and dispose of refrigerant in compliance with local, federal, and EPA regulations and requirements.
- B. Documentation: Maintain documentation for all refrigerant brought onto or removed from project location in compliance with local, federal, and EPA regulations and requirements. Submit documentation to the Owner and Architect.

3.3 AS-BUILT DRAWINGS AND RECORD DOCUMENTS

- A. Recording: Post changes and modifications to the As-Built Drawings as they occur; do not wait until the end of the project.
- B. Maintenance of As-Built Drawings and Record Documents: Store Record Documents in the field office, apart from the Contract Documents used for construction. Do not use project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project Record Documents for the Engineer's reference during normal working hours. As-Built Drawings will be reviewed by the Architect, Owner, and Engineer at each pay request review.
- C. Submit As-Built Drawings to the Architect at completion of the project.

3.4 OPERATION AND MAINTENANCE MANUALS

- A. Prepare Operation and Maintenance Manuals as directed.
- B. Submit a preliminary electronic copy of the Operation and Maintenance Manual to the Engineer for review.
- C. Make any corrections noted from the Engineer's review upon receipt of comments and resubmit as required.
- D. Submit the final, corrected Operation and Maintenance Manual in both paper and electronic format to the Architect.

3.5 VERIFICATION OF DIMENSIONS

- A. Scaled and figured dimensions are approximate only. Before proceeding with work, carefully check and verify dimensions at site, and be responsible for properly fitting equipment and materials together and to the structure in spaces provided.
- B. Drawings are diagrammatic and many offsets, bends, special fittings and exact locations are not indicated. Carefully study drawings and premises in order to determine best sequence and installation methods, exact locations, routes, building obstructions, and install apparatus and equipment in available locations. Install apparatus and equipment in manner and in locations to avoid obstructions, preserve headroom, and keep openings and passageways clear.

3.6 CUTTING AND PATCHING

- A. Cut work and patch per Division 01 specifications as necessary to properly install the new work. As the work progresses, coordinate necessary openings, holes, chases, etc., in their correct location. If the required openings, holes and chases are not in their correct locations, make the necessary corrections at no cost to the Owner. Avoid excessive cutting and do not cut structural members without the consent of the Architect. Include as a part of the work all structural framing required by penetrations through the roof and necessary design and installation of steel to support equipment, ducts and pipes between structural steel unless shown on the structural drawings.

3.7 CLOSING-IN OF UNFINISHED WORK

- A. Cover no work until inspected, tested and approved. Where work is covered before inspection and test, uncover it, and when inspected, tested and approved, restore all work to original proper condition.

3.8 EXCAVATION AND BACKFILL

- A. Perform all necessary excavation, shoring and backfilling required for the proper laying of all pipes, ducts, and conduits inside the building and premises, and outside as may be necessary. Remove all excess excavated materials from the site or dispose of onsite as directed by the General Contractor.
- B. Excavate all trenches open cut, keep trench banks as nearly vertical as practicable, and sheet and brace trenches where required for stability and safety. Excavate trenches true to line and make bottoms not less than 18 inches wide but no wider than necessary to provide ample work room. Excavate to provide continuous granular bedding as indicated. Do not cut any trench near or under footings without first consulting the Architect. Comply with OSHA requirements.
- C. Provide not less than 4 inches of granular material as duct or pipe bedding. Grade and compact trench bedding accurately prior to laying duct or pipe in trench to provide uniform bearing and support for each section of pipe along its entire length. Dig "bell" holes after the trench bottom has been graded and compacted. Granular material shall be pea gravel or sand per MAG Standards.
- D. Provide backfilling and compaction in accordance with provisions of these specifications and under the direction of the Architect to the required density.
- E. Provide not less than 4 inches of granular material, the same as duct or piping bedding, all around duct or pipe. Make the first 2 feet of fill in 6-inch layers, each thoroughly compacted as directed with no puddling, and free from rocks, large clods of earth, leaves, branches, and debris. Compact the rest of the backfill as directed, using in the backfill no rocks larger than 4 inches in diameter, and using no rock in the top 12 inches.

3.9 ACCESSIBILITY

- A. Install valves, dampers, thermometers, gauges, traps, cleanouts, control devices or other specialties requiring reading, adjustment, inspection, repairs, removal or replacement conveniently and accessibly throughout the finished building. Where any of these devices are shown on the Contract Drawings to be installed above any inaccessible ceiling or behind any inaccessible wall, the Mechanical Contractor shall furnish access doors or panels as required.
- B. All access doors or panels in walls and ceilings required for access to control devices, traps, valves and similar devices are to be furnished and installed as part of the work under this section. Provide type as specified in Division 08 specifications.
- C. Where any duct-mounted access doors or other items requiring access or maintenance are installed above an inaccessible ceiling or behind an inaccessible wall, the Mechanical Contractor shall furnish access doors or panels as required unless noted otherwise. Provide type as specified in Division 08 specifications.
- D. Refer to architectural drawings for type of wall and ceiling in each area and for rated construction.
- E. Coordinate work of various sections to locate valves, traps, and dampers with others to avoid unnecessary duplication of access doors.
- F. The Contractor, along with the Owner's representative, shall complete the Mechanical Accessibility/Clearance Checklist at the end of this section for all mechanical equipment. The chart shall be submitted to the Architect for approval prior to Substantial Completion. All conflicts shall be resolved to the Architect's and Owner's satisfaction prior to submission.

3.10 FLASHINGS

- A. Flash and counterflash all piping, conduits and ductwork penetrating roofing membrane with flashing per roofing manufacturer's recommendations. Refer to architectural drawings for detailing of duct and pipe penetrations through roof.
- B. Flash and counterflash all piping, conduits and ductwork penetrating exterior walls. Refer to architectural drawings for detailing of duct and pipe penetrations through walls.

3.11 PRODUCT AND EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. All equipment, valves, sensors, dampers, detectors, etc., shall be installed in strict conformance with the manufacturer's recommendations and all codes.
- B. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.
- C. Install equipment, ductwork, and piping level and plumb, parallel and perpendicular to other building systems and components, unless otherwise indicated.
- D. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- E. Install equipment, ductwork, and piping to allow right-of-way for piping installed at required slope.
- F. Do not install any equipment in an application not recommended by the manufacturer.

3.12 EQUIPMENT ROUGH-IN

- A. Rough in all equipment and fixtures as designated on the approved submittals and in the Construction Documents. The Contract Drawings indicate only the approximate location of rough-ins. The exact rough-in locations must be determined from large-scale certified drawings. The Contractor shall obtain all certified rough-in information before progressing with any work for rough-in.
- B. Be responsible for providing all outlets and services of proper size at the required locations.
- C. Minor changes in the Contract Drawings shall be anticipated and provided for under this Contract.
 - 1. Rough-in only (unless otherwise designated on the drawings) shall include providing all services as indicated and required, including all ductwork, piping, valves, and fittings. Valve and cap all piping stub-outs. Cap all ductwork stub-outs in a manner suitable for future extension.

3.13 OWNER-FURNISHED AND OTHER EQUIPMENT

- A. Rough-in only for all Owner-furnished equipment (refer to Division 01 specifications) and all equipment furnished under other sections of the specifications, except as otherwise specified and/or noted on the drawings.
- B. Obtain rough-in drawings from the Owner or other contractors prior to roughing-in any services.
- C. Provide all services required. Valve and cap all piping, cap all ductwork, and leave in a clean and orderly manner.

3.14 EQUIPMENT FINAL CONNECTIONS

- A. Provide all piping and duct final connections for all equipment under Division 23 and as indicated on the drawings.

3.15 MACHINERY DRIVES

- A. After tests have been performed on the air-conditioning and air-handling systems, make without cost, not more than one change in the size of non-adjustable sheaves to obtain the required air quantities as direct by the Test and Balance Contractor.

3.16 EQUIPMENT SUPPORTS

- A. Erection of Metal Supports and Anchorages:
 - 1. Refer to Division 05 specifications for structural steel.
 - 2. Design, cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment. Neatly fabricate and erect steel work with burrs and welding spatter ground off. Paint after fabrication with a rust-inhibitive primer.
 - 3. Field Welding: Comply with AWS D1.1.
- B. Erection of Wood Supports and Anchorages:
 - 1. Design, cut, fit, and place wood grounds, nailers, blocking, and anchorages to support and anchor mechanical materials and equipment.

2. 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.
 3. Attach to substrates as required to support applied loads.
- C. Where supports, foundations, stands, suspended platforms for machinery, tanks, or other equipment are indicated or specified, perform the following:
1. Locate support members to avoid equipment strainers and interference with piping connections, tube pulling or other maintenance operations.
 2. Where saddles are required, use cast-iron or welded-steel saddles with curvature to fit the tank shell.
 3. Mount power-driven equipment on common base with driver.
- D. Concrete Inserts: Furnish and install all concrete inserts required for all materials and equipment specified and/or shown on the drawings for Division 23.
- E. Concrete Housekeeping Pads and Isolation Bases: Work under this section includes coordination of construction of all concrete foundations indicated or required for equipment specified under Division 23. Materials and workmanship shall be described in Division 03 specifications. Anchor equipment to concrete housekeeping pads and isolation bases according to equipment manufacturer's written instructions and according to seismic codes at project.
1. Construct concrete housekeeping pads and isolation bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 2. Install dowel rods to connect concrete pads to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the pad.
 3. Install epoxy-coated anchor bolts for supported equipment that extends through concrete pads, 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.
- F. Grouting:
1. Grout under all equipment after leveling, filling completely the space between machinery bed plate and foundation surface as specified in Division 03 specifications.
 2. Mix and install grout for mechanical equipment base bearing surfaces, pumps and other equipment base plates, and anchors.
 3. Clean surfaces that will come into contact with grout.
 4. Provide forms as required for placement of grout.
 5. Avoid air entrapment during placement of grout.
 6. Place grout, completely filling equipment bases.
 7. Place grout on concrete pads and isolation bases and provide smooth bearing surface for equipment.
 8. Place grout around anchors.
 9. Cure placed grout.
 10. Finish exposed surface of grout for a neat appearance.

3.17 CLEANUP

- A. In addition to cleanup specified in Division 01 specifications, thoroughly clean all parts of the equipment. Where exposed parts are to be painted, thoroughly clean off any splattered construction materials and remove all oil and grease spots. Wipe the surface carefully and scrape out all cracks and corners.
- B. During the progress of the work, keep the premises clean and free of debris.

3.18 PAINTING

- A. Except as otherwise specified or indicated in the architectural drawings and/or specifications, paint all exposed unfinished metal pipe, duct, hangers, supports, rods, hardware, and equipment with one coat of rust-inhibiting primer. Galvanized, stainless-steel, or aluminum ductwork, pipe, supports, hangers, rods and hardware, and factory-painted equipment shall be considered as having primed surface.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- C. Finished painting is specified in Division 09 specifications.

3.19 FIRESTOPPING

- A. Coordinate with the firestopping installer for sealing of all penetrations of fire and smoke barriers and other rated assemblies created during the installation of the Division 23 work.

3.20 OBJECTIONABLE NOISE AND VIBRATION

- A. Design, construct and brace the metal partitions, ducts and sheet metal housings to prevent vibration or rattling when systems are in operation. Install connections to equipment so noise and vibration will not reach the conditioned area through ducts, piping, conduit, sheet metal work, or the building structure.

3.21 WELDING

- A. Procedures:
 - 1. All procedures and welders must be qualified in accordance with the requirements of Section IX, ASME Boiler and Pressure Vessel Code and ANSI code for power piping B31.1. Procedure qualification test records and acceptance shall be submitted with the welding procedure prior to the start of fabrication.
 - 2. The Architect's inspector or authorized representative will review performance qualification records of individual welders.

END OF SECTION

Edition -----1219

SECTION 23 05 01

DEMONSTRATION & TRAINING FOR HVAC SYSTEMS & COMPONENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes administrative and procedural requirements for demonstration of proper operation of equipment and instructing the 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.

1.2 CLOSEOUT SUBMITTALS

- A. At completion of training, submit complete training manual(s) for the Owner's use.

1.3 QUALITY ASSURANCE

- A. Instructor Qualifications: A factory-authorized service representative experienced in operation and maintenance procedures and training.

1.4 COORDINATION

- A. Complete demonstrations prior to Substantial Completion.
- B. Complete instruction prior to Final Completion.
- C. Coordinate demonstration and instruction schedule with the Owner's operations. Adjust schedule as required to minimize disrupting the Owner's operations.
- D. Coordinate content of training modules with content of approved Operation & Maintenance Manuals.

PART 2 - PRODUCTS

2.1 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. Include training for all HVAC systems and equipment such as heat pumps, air-conditioners, heating and ventilating units, evaporative coolers, make-up air units, chillers, cooling towers, pumps, fans, air handlers, etc., and 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. Operating standards.
 - c. Regulatory requirements.
 - d. Equipment function.
 - e. Operating characteristics.
 - f. Limiting conditions.
 - g. Performance curves.
 2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Operation & maintenance manuals.
 - c. Project record documents.
 - d. Identification systems.
 - e. Warranties and bonds.
 - f. Maintenance service agreements and similar continuing commitments.
 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
 5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning.
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance including the following:
 - 1) Lubrication.
 - 2) Filter replacement.
 - 3) Belt tensioning.
 - 4) Belt replacement.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts, including lubricants, filters, and belts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Inspect and test each system, subsystem and piece of equipment prior to demonstration. Confirm proper operation prior to scheduling demonstrations.
 1. Replace defective work or material.
 2. Repeat inspection and testing until defects are eliminated.
- B. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements for operation and maintenance data.

3.2 DEMONSTRATION

- A. Inspect and operate satisfactorily, in the presence of the Engineer and Owner, each system and item of equipment, including accessories.

3.3 INSTRUCTION

- A. Engage qualified instructors to instruct the Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. The Owner will furnish the Contractor with names and positions of participants.
- B. Scheduling: Provide instruction at mutually agreed-upon times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with the Owner with an advance notice of at least 7 days.
- C. Evaluation: At the conclusion of each training module, assess and document each participant's mastery of the module by use of an oral or demonstration performance-based test.

END OF SECTION

Edition 0208-1015

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes general requirements for single-phase and polyphase, general-purpose, horizontal and vertical, small and medium, squirrel-cage induction motors for use on AC power systems up to 600 volts and installed at equipment manufacturer's factory or shipped separately by the equipment manufacturer for field installation.

1.2 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.
 - 5. Variable frequency and variable speed drives.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this section except when stricter requirements are specified in HVAC equipment schedules or sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.
- C. Motors 3/4 HP and larger, except as otherwise noted, shall be designed for 3 phase, 60 Hz power supply.
- D. Motors 1/2 HP and smaller, except as otherwise noted, shall be designed for 120 volt, single phase, 60 Hz power supply.
- E. Motors not directly exposed to weather and located in non-hazardous spaces shall be in dripproof enclosures or as indicated on the drawings.
- F. Motors shall be totally enclosed, fan cooled where directly exposed to weather or as indicated on the drawings.
- G. High-starting torque, totally enclosed or explosion-proof motors to be used in all hazardous areas or as indicated on the drawings.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 104°F and at an altitude of 3,300 feet above sea level.

- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multi-Speed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.
- F. Bearings: Regreasable, shielded, anti-friction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating.
- H. Insulation: Class F.
- I. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multi-Speed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers:
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
 - 5. Bearing Protection Device: Field- or factory-applied shaft grounding ring consisting of metal ring supporting carbon microfibers to provide grounding path between shaft and motor casing.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 HP shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
 - 5. Electronically commutated.
- B. Multi-Speed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, anti-friction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Insulation: Class F where motors are installed on roofs outside the airstream.
- E. Motors 1/20 HP and Smaller: Shaded-pole type.
- F. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

2.6 ELECTRONICALLY COMMUTATED MOTOR

- A. Description: Motor with integral electronics to convert incoming AC power to DC power to drive motor shaft along with controls to vary the speed of the motor based on an internal or external signal.
- B. Controls: Provide with internal controls and programming or external inputs, depending on the application, to allow for motor speed control.
- C. Motor Protection: Provide with integral safeties to limit motor speed or de-energize motor if operating in an over-temperature or overloaded condition.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Arrange and set motors.
- B. Line up motors on direct drive equipment using dial-type gauges.
- C. Connections and testing of motor for proper rotation/phasing shall be under Division 26.

END OF SECTION

Edition 0605-1018

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SECTION 23 05 17

SLEEVES & SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes:
 - 1. Sleeves.
 - 2. Sleeve-seal systems.
 - 3. Grout.

1.2 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 A53/A53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. Galvanized-Steel-Sheet Sleeves: Minimum thickness 0.0239-inch; round tube closed with welded longitudinal joint.

2.2 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. CALPICO, Inc.
 - 3. Link-Seal by GPT, an EnPro Industries Company.
 - 4. The Metraflex Company.
 - 5. Proco Products, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 1. Sealing Elements: EPDM-rubber or NBR 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 or reinforced nylon polymer.

3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 GROUT

- A. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Non-shrink; recommended for interior and exterior applications.
- C. Design Mix: 5,000-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.
 1. Sleeves are not required for core-drilled holes through exterior walls or slab-on-grade floors.
- 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 interior of sleeve.
 1. For core-drilled holes, size hole large enough to provide 1-inch annular space between piping and concrete wall or slab-on-grade floor.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 2. Using grout, seal the space outside of sleeves in slabs and walls.
- D. Install sleeves in core-drilled holes in concrete floors in mechanical equipment areas or other wet areas.
 1. Extend sleeves 2 inches above finished floor level.
 2. Using grout, seal the space outside of sleeves.
- E. 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 specifications.

- F. 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 specifications.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

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

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete Walls Above Grade:
 - a. Piping Smaller than NPS 4: Cast-iron wall sleeves, galvanized-steel wall sleeves, or galvanized-steel-pipe sleeves.
 - b. Piping NPS 4 and Larger: Cast-iron wall sleeves or galvanized-steel-pipe sleeves.
 - 2. Exterior Concrete Walls Below Grade:
 - a. Piping Smaller than NPS 4: Cast-iron wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 4 and Larger: Cast-iron wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - 3. Concrete Foundation or Stem Walls Below Grade:
 - a. Piping Smaller than NPS 4: Cast-iron wall sleeves.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve.
 - b. Piping NPS 4 and Larger: Cast-iron wall sleeves.
 - 4. Concrete Slabs-on-Grade: Cast-iron wall sleeves with sleeve-seal system.
 - a. Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - 5. Concrete Slabs Above Grade: Galvanized-steel-pipe sleeves.
 - 6. Interior Partitions:
 - a. Piping Smaller than NPS 6: Galvanized-steel-pipe sleeves.

- b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION

Edition 0308-0715

SECTION 23 05 18

ESCUTCHEONS FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.2 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 set screw 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.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw and polished chrome-plated finish.

2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- B. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Insulated Piping: One-piece, stamped-steel type.
 - c. Bare Piping: One-piece, cast-brass type.

2. Escutcheons for existing piping shall be split-casting, cast-brass type.
 - C. Install floor plates for piping penetrations of equipment-room floors.
 - D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 1. New Piping: One-piece, floor-plate type,
 2. Existing Piping: Split-casting, floor-plate type.
- 3.2 FIELD QUALITY CONTROL
- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

Edition 0308-1109

SECTION 23 05 20

ELECTRICAL & CONTROL WIRING FOR MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section is to be used for all low- and line-voltage wiring for mechanical controls. All line-voltage work shall be performed by a licensed contractor qualified to perform the work and shall comply with the requirements contained in this section or in Division 26.
- B. This section does not apply to plenum rated cables used for electrically activated remote damper operators.
- C. This section includes the following:
 - 1. Metal conduits, tubing, and fittings.
 - 2. Non-metallic conduits, tubing, and fittings.
 - 3. Metal wireways and auxiliary gutters.
 - 4. Surface raceways.
 - 5. Boxes, enclosures, and cabinets.
 - 6. Low-voltage control cabling.
 - 7. Conductors and cables rated 600 volts and less.
 - 8. Connectors, splices, and terminations rated 600 volts and less.
 - 9. Identification of power and control cables.
 - 10. Identification for conductors.
 - 11. Underground-line warning tape.

1.2 DEFINITIONS

- A. Low-Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 volts or for remote-control and signaling power-limited circuits.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated, include manufacturer's technical data, materials of construction, and listings.
- B. Field quality-control test reports.
- C. Maintenance data.

1.4 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 50 or less.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to the Authorities Having Jurisdiction (AHJ), and marked for intended use.
- C. Comply with NFPA 70.
- D. Comply with ANSI A13.1 for identification devices.

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. IMC: Comply with ANSI C80.6 and UL 1242.
- D. EMT: Comply with ANSI C80.3 and UL 797.
 - 1. Color: Factory-applied color per schedule below.
 - a. HVAC Control Wiring: White.
 - b. Power – Normal: Natural.
 - c. Power – Standby: Orange.
- E. FMC: Comply with UL 1; zinc-coated steel or aluminum.
- F. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
 - 2. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Set screw or compression.
 - 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
- H. Joint Compound for IMC or GRC: Approved, as defined in NFPA 70, by the AHJ 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 NON-METALLIC CONDUITS, TUBING, AND FITTINGS

- A. Listing and Labeling: Non-metallic 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. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Sheet metal, complying with UL 870 and NEMA 250; Type 1, Type 3R, Type 4 or Type 12, as required by location; 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.

2.4 SURFACE RACEWAYS

- A. Listing and Labeling: Surface 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: Galvanized steel with snap-on covers complying with UL 5. Where installed in finished spaces, match color of adjacent surfaces.

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. Box extensions used to accommodate new building finishes shall be of the same material as the recessed box.
- D. Device Box Dimensions: 4" square x 2-1/8" deep or 4" x 2-1/8" x 2-1/8" deep.
- E. Gangable boxes are prohibited.
- F. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250; Type 1, Type 3R, Type 4 or Type 12, as required by location; with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- G. Cabinets:
 - 1. NEMA 250; Type 1, Type 3R or Type 12, as required by location; galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.

2.6 LOW-VOLTAGE CONTROL CABLE

- A. Paired Cable: NFPA 70, Type CMG.
 - 1. One pair, twisted, #16 or #18 AWG, stranded (19 x 29) tinned-copper conductors.
 - 2. PVC insulation.
 - 3. Unshielded.
 - 4. PVC jacket.
 - 5. Flame Resistance: Comply with UL 1581.

2.7 CONDUCTORS AND CABLES

- A. Copper Conductors: Comply with NEMA WC 70.
- B. Conductor Insulation: Comply with the following:
 - 1. NEMA WC 70 for Types THHN-THWN and XHHW.
 - 2. UL 83 for Types TW and TF.

2.8 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. 3M; Electrical Products Division.
 - 2. AFC Cable Systems, Inc.
 - 3. Hubbell Power Systems, Inc.
 - 4. O-Z/Gedney; EGS Electrical Group LLC.
 - 5. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.9 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.
- D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

2.10 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.11 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
 - 1. Recommended by the manufacturer for the method of installation and suitable to identify and locate underground electrical and control lines.
 - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
 - 1. Comply with ANSI Z535.1 through ANSI Z535.5.
 - 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
 - 3. Inscriptions for Orange-Colored Tapes: CONTROL CABLE.
- C. Tag: Type ID:
 - 1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
 - 2. Overall Thickness: 5 mils.
 - 3. Foil Core Thickness: 0.35 mil.
 - 4. Weight: 28 lb./1,000 sq.ft.
 - 5. 3-Inch Tensile According to ASTM D882: 70 lbf and 4,600 psi.

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: GRC, IMC, or EMT.
 - 3. Underground Conduit: RNC, Type EPC-40-PVC or Type EPC-80-PVC, direct buried or concrete encased.
 - 4. Connection to Vibrating Equipment (Including Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- 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 but not limited to:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Gymnasiums.
 4. Concealed in Interior Walls and Partitions: EMT.
 5. Concealed Above or In Ceilings: EMT.
 6. Connection to Vibrating Equipment (Including Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 7. Damp or Wet Locations: GRC or IMC.
 8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Raceway Size: Trade size 3/4 inch.
- 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 set screw 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. Do not install aluminum conduit, boxes, or fittings in contact with concrete or earth.
- F. Install surface raceways only in retrofit applications where indicated.

3.2 RACEWAY INSTALLATION

- A. Install all cabling, conductors, and wiring in raceways except where noted otherwise on the drawings or in other sections.
- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on the 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.
- C. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- D. Comply with requirements in Specification Section 23 05 29, Hangers and Supports for HVAC Piping and Equipment, for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches of enclosures to which attached.

- I. Raceways Embedded in Slabs:
1. Run conduit larger than 1 inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 3. Arrange raceways to keep a minimum of 1 inch of concrete cover in all directions.
 4. Do not embed threadless fittings in concrete unless specifically approved by the Architect for each specific location.
- J. Stub-Ups to Above Recessed Ceilings:
1. Use EMT, IMC, or GRC for raceways.
 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- K. 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.
- L. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than #4 AWG.
- M. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb. tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- N. Surface Raceways:
1. Install surface raceway with a minimum 2-inch radius control at bend points.
 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- O. 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.
- P. 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 conduits pass from humidity controlled spaces to non-humidity controlled spaces.
 3. Where an underground service raceway enters a building or structure.
 4. Where otherwise required by NFPA 70.
- Q. Expansion-Joint Fittings:
1. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

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.
- R. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 48 inches of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for motors.
1. Use FMC in indoor, dry locations.
 2. Use LFMC in all other locations.
- S. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- T. Locate boxes so that cover or plate will not span different building finishes.
- U. 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.
- V. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 specifications for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Division 31 specifications.
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 specifications.
4. Install manufactured rigid steel conduit elbows for stub-ups at equipment and at building entrances through floor.
 - a. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

3.4 CONDUCTOR MATERIAL APPLICATIONS

A. Control Circuit Sizing: Minimum sizes are listed below:

1. Class 1 remote-control and signal circuits, #14 AWG.
2. Class 2 low-energy, remote-control, and signal circuits, #16 AWG.
3. Class 3 low-energy, remote-control, alarm, and signal circuits, #12 AWG.

B. Branch Circuits: Copper. Solid for #10 AWG and smaller; stranded for #8 AWG and larger.

- C. Branch Circuit Sizing: Size conductors for circuits with less than a 20 ampere connected load, maximum of 16 amperes actual load, as follows:
1. For 120-volt circuits up to 65 feet in length from panel to center of load: Not smaller than No. 12.
 2. For 120-volt circuits up to 110 feet in length from panel to center of load: Not smaller than No. 10.
 3. For 120-volt circuits up to 165 feet in length from panel to center of load: Not smaller than No. 8.
 4. For 120-volt circuits up to 255 feet in length from panel to center of load: Not smaller than No. 6.
 5. For 208-volt circuits up to 110 feet in length from panel to center of load: Not smaller than No. 12.
 6. For 208-volt circuits up to 185 feet in length from panel to center of load: Not smaller than No. 10.
 7. For 208-volt circuits up to 280 feet in length from panel to center of load: Not smaller than No. 8.
 8. For 208-volt circuits up to 440 feet in length from panel to center of load: Not smaller than No. 6.
 9. For 277-volt circuits up to 150 feet in length from panel to center of load: Not smaller than No. 12.
 10. For 277-volt circuits up to 250 feet in length from panel to center of load: Not smaller than No. 10.
 11. For 277-volt circuits up to 380 feet in length from panel to center of load: Not smaller than No. 8.
 12. For 277-volt circuits up to 590 feet in length from panel to center of load: Not smaller than No. 6.

3.5 CONDUCTOR INSULATION APPLICATIONS AND WIRING METHODS

- A. Comply with NECA 1.
- B. Exposed Branch Circuits, including in Crawlspace: Type THHN-THWN or XHHW, single conductors in raceway.
- C. Branch Circuits Concealed in Walls, and Partitions: Type THHN-THWN or XHHW, single conductors in raceway.
- D. Branch Circuits Concealed Above or in Ceilings: Type THHN-THWN or XHHW, single conductors in raceway.
- E. Branch Circuits Concealed Above Lay-In Ceilings: Type THHN-THWN or XHHW, single conductors in raceway.
- F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN or XHHW, single conductors in raceway.
- G. Class 1 and 2 Control Circuits: Type THHN-THWN or XHHW, in raceway unless noted otherwise.
1. Final raceway connections for low-voltage control wiring to equipment, actuators and similar devices may be omitted where the devices are located above lay-in ceilings. Length of exposed wire is to be less than 24 inches.
- H. Class 3 Control Circuits: Type TW or TF in raceway unless noted otherwise.

1. Final raceway connections for low-voltage control wiring to equipment, actuators and similar devices may be omitted where the devices are located above lay-in ceilings. Length of exposed wire is to be less than 24 inches.

3.6 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal raceways in finished walls, ceilings, and floors, unless otherwise indicated.
- B. 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.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.
- D. Install raceways parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Specification Section 23 05 29, Hangers and Supports for HVAC Piping and Equipment.
- F. Identify and color-code conductors and cables.
- G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- H. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

3.7 IDENTIFICATION INSTALLATION

- A. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by the manufacturer of the identification device.
- C. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

3.8 IDENTIFICATION SCHEDULE

- A. Power-Circuit Conductor Identification, 600 Volts or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
 1. Color-Coding for Phase and Voltage Level Identification, 600 Volts or Less: Use colors listed below for ungrounded branch-circuit conductors.
 - a. Color shall be factory applied.

b. Colors for 208/120-Volt Circuits:

- 1) Phase A: Black.
- 2) Phase B: Red.
- 3) Phase C: Blue.
- 4) Neutral: White.

c. Colors for 480/277-Volt Circuits:

- 1) Phase A: Brown.
- 2) Phase B: Orange.
- 3) Phase C: Yellow.
- 4) Neutral: Gray.

B. Control Systems Conductor Identification: Identify field-installed 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 the system used by the manufacturer for factory-installed connections.
3. Coordinate identification with the Project Drawings, manufacturer's wiring diagrams, and the Operation & Maintenance Manual.

C. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Install underground-line warning tape for both direct-buried cables and cables in raceway.

3.9 REMOVAL OF CONDUCTORS AND CABLES

- A. Remove abandoned conductors and cables.

3.10 GROUNDING

- A. For low-voltage wiring and cabling, comply with requirements in Division 26.

3.11 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 Specification Section 23 05 17, Sleeves and Sleeve Seals for HVAC Piping.

3.12 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Comply with requirements in Division 07 specifications.

3.13 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by the manufacturer.
2. Repair damage to paint finishes with matching touchup coating recommended by the manufacturer.

3.14 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections: Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

Edition-----0819

SECTION 23 05 29

HANGERS & SUPPORTS FOR HVAC PIPING & EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes:
 - 1. Metal pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Thermal-hanger shield inserts.
 - 4. Fastener systems.
 - 5. Equipment supports.
 - 6. Non-penetrating rooftop bases.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water with no load transmitted to connected equipment.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include product data for components:
 - 1. Trapeze pipe hangers.
 - 2. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by a qualified professional engineer responsible for their preparation.
- D. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, Structural Welding Code - Steel.

- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Surface-Burning Characteristics: For tapes, as determined by testing identical products according to ASTM E84, by a testing agency acceptable to the Authorities Having Jurisdiction. Factory-label tapes with appropriate markings of the applicable testing agency.
 - 1. Tape Installed in Return Plenums: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Tape Installed Elsewhere: No testing requirement.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers shall be one of the following unless noted otherwise:
 - 1. Anvil International.
 - 2. B-Line Systems.
 - 3. Elgen.
 - 4. Kin-Line.
 - 5. Michigan Hanger Co.
 - 6. National Pipe Hanger Corp.
 - 7. PHD Manufacturing.
 - 8. PHS Industries.
 - 9. Pipe Technology and Products.
 - 10. Unistrut.

2.2 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 - 3. Non-Metallic 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 or stainless steel.
- B. Stainless-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

2.3 TRAPEZE PIPE HANGERS

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

2.4 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Hot or Cold Piping: ASTM C552, Type II cellular glass with 100-psig or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- B. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- C. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- D. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.
- E. Shield: Shields shall be a minimum of 18 gauge galvanized steel, 12 inches long for piping 6 inches and smaller. Shields shall be a minimum of 16 gauge galvanized steel, 18 inches long for pipe over 6 inches.

2.5 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.6 NON-PENETRATING ROOFTOP BASES

- A. Subject to compliance with requirements, manufacturers shall be one of the following:
 - 1. Dymotek.
 - 2. Miro Industries, Inc.
 - 3. PHP Systems Design.
- B. Description: Stainless-steel or polycarbonate bases designed for direct placement on roofing membrane.
 - 1. General:
 - a. All edges and corners in contact with the roof surface shall be rounded to prevent damage to the roof membrane.
 - b. Drainage ports shall be provided to prevent ponding of water within the base.
 - c. The bottom of the base shall be solid and flat, free of voids and deformities to prevent concentrated loading of the roofing membrane.
 - d. Polycarbonate bases shall be UV stabilized with carbon black.

2. Supports: Pipe, conduit, duct, and equipment supports mounted to roof bases shall be constructed as outlined above. Integral supports for small diameter piping and conduit may be integral with polycarbonate bases.
3. Protective Pads: 1/8-inch-thick, flexible PVC with carbon black additive for UV stabilization, protective pad for placement beneath roof bases to protect roofing membrane.

2.7 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and non-metallic grout; suitable for interior and exterior applications.
 1. Properties: Non-staining, non-corrosive, and non-gaseous.
 2. Design Mix: 5,000-psi, 28-day compressive strength.
- C. Tape for Plenum Use:
 1. Polypropylene backing with acrylic adhesive, Hart & Cooley Part No. 011371.
 2. Polyethylene-coated cloth backing with rubber adhesive, Uline Black Nashua 398 Duct Tape, Model No. S-17236BL.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 2. Field fabricate from ASTM A36/A36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Hanger Sizing: Size hangers on insulated piping to fit outside of covering.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation: Install fasteners in strict accordance with manufacturer's written instructions.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- M. Insulated Piping: Thermal-hanger shield inserts shall be used. Install with insulation the same thickness as piping insulation. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
- N. Conduit Support Installation:
 - 1. Comply with NECA 1 and NECA 101 for installation requirements, except as specified in this article.
 - 2. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
 - 3. 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 lbs.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead, or to support equipment above floor or roof.
- B. Grouting: Place non-shrink grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

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

3.5 PAINTING

- A. Refer to General Provisions for rust inhibiting primer.
- B. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use the same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- C. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 specifications.
- D. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system sections.
- C. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
- D. Use hangers and supports with galvanized metallic coatings for piping and equipment that is exposed to weather and that will not have field-applied finish.
- E. Use stainless-steel pipe hangers and stainless-steel attachments for corrosive atmospheres.
- F. Wrap copper piping with not less than two layers of 10-mil-thick black plastic tape extending a minimum of 1 inch on each side of clamp for electrolytic protection where hangers or supports are in direct contact with copper piping.

- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1,050°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. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 1-1/2 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.
 - 5. Single-Pipe Rolls (MSS Type 43): For suspension of pipes NPS 1 to NPS 30, with one rod if longitudinal movement caused by expansion and contraction might occur.
 - 6. 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.
 - 7. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- K. Conduit Support Applications:
 - 1. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical conduit.
 - 2. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
 - 3. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel-slotted or other support system, sized so capacity can be increased by at least 25% in future without exceeding specified design load limits.
 - a. Secure raceways and cables to these supports with two-bolt conduit clamps or single-bolt conduit clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13).
 - 2. Steel Clevises (MSS Type 14): For 120 to 450°F piping installations.

- M. Building Attachments: Unless otherwise indicated and except as specified in piping system sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS-Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape. Include retaining clip.
 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. Include retaining clip.
 7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lbs.
 - b. Medium (MSS Type 32): 1,500 lbs.
 - c. Heavy (MSS Type 33): 3,000 lbs.
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- N. Roof Bases: Unless otherwise indicated install roof bases for roof-mounted piping, conduit, ductwork, and equipment as follows:
1. Select roof base size based on expected load to prevent crushing of the roofing membrane and underlying insulation.
 2. Space roof bases as required to properly support conduit, pipes, or ducts, or more frequently to distribute the weight of the supported systems to prevent damage to the roofing membrane, underlying insulation, or roofing system.
 3. Provide protective pads between each roof base and the roofing membrane. Size pads to extend a minimum of 2 inches beyond each roof base.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
- P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system sections.

END OF SECTION

Edition 0907-1015

SECTION 23 05 48.13

VIBRATION CONTROLS FOR HVAC PIPING & EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the following:
 - 1. Isolation pads.
 - 2. Freestanding spring isolators.
 - 3. Housed spring mounts.
 - 4. Spring hangers.
 - 5. Spring hangers with vertical-limit stops.

1.2 DEFINITIONS

- A. Sound Critical: Assembly spaces such as classrooms, auditoriums, etc.; normally occupied rooms such as offices, call centers, etc.; vibration critical areas such as data rooms, technical manufacturing areas, etc.; or other areas as indicated.
- B. Non-Sound Critical: Not normally occupied areas such as storage rooms, electrical rooms, mechanical yards, commercial kitchens, scullery areas, etc.

1.3 SUBMITTALS

- A. Product Data: For each product indicated.
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
- B. Welding certificates.
- C. Field quality-control test reports.

1.4 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, Structural Welding Code - Steel.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Manufacturers: The following products are based on Mason Industries. Subject to compliance with requirements, provide comparable products by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. Kinetics Noise Control.

3. Mason Industries.
 4. Vibration Mountings & Controls, Inc.
- B. Neoprene Pad: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a non-slip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
1. Resilient Material: Oil- and water-resistant neoprene.
- C. Style D - Restrained Spring Isolators: Freestanding, steel, open-spring isolators with limit-stop 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.
 2. Restraint: Limit-stop as required for equipment and the Authorities Having Jurisdiction.
 3. Outside Spring Diameter: Not less than 80% of the compressed height of the spring at rated load.
 4. Minimum Additional Travel: 50% of the required deflection at rated load.
 5. Lateral Stiffness: More than 80% of rated vertical stiffness.
 6. Overload Capacity: Support 200% of rated load, fully compressed, without deformation or failure.
- D. Style F - Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80% of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50% of the required deflection at rated load.
 4. Lateral Stiffness: More than 80% of rated vertical stiffness.
 5. Overload Capacity: Support 200% of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Elements: Molded, oil-resistant rubber or neoprene.
 - a. Minimum 1-1/4-inch-thick element at top of hanger with steel-washer-reinforced rod support and bushing projecting through top of frame.
 - b. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- E. Style G - Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80% of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50% of the required deflection at rated load.

4. Lateral Stiffness: More than 80% of rated vertical stiffness.
5. Overload Capacity: Support 200% of rated load, fully compressed, without deformation or failure.
6. Elastomeric Elements: Molded, oil-resistant rubber or neoprene.
 - a. Minimum 1-1/4-inch-thick element at top of hanger with steel-washer-reinforced rod support and bushing projecting through top of frame.
 - b. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.2 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled equipment before shipping.
 1. Powder coating on springs and housings.
 2. All hardware shall be zinc electroplated.
 3. Baked enamel or powder coat for metal components on isolators for interior use.
 4. Color-code or otherwise mark vibration isolation control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Engage a factory-authorized representative to inspect the intended equipment locations for deficiencies and to instruct installers in correct equipment installation procedure and sequence.
- B. Examine areas and equipment to receive vibration isolation devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- C. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application.
- B. 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.

- C. Select vibration isolation elements and deflections in accordance with the following table:

Equipment	Location	Vibration Isolation Element (Minimum Deflection)
Ceiling Mounted Equipment Fan Coil Units Indoor Units Watersource Heat Pumps Inline Fans Fan-Powered VAV Boxes	Suspended	Style F (0.75 inches $\leq$ 5 HP) (1.5 inches $\geq$ 7.5 HP)
Piping	Where connected to equipment with spring isolators.	Style G on first four hangers (match equipment deflection)

3.3 VIBRATION-CONTROL INSTALLATION

- A. Install bushing assemblies for mounting bolts for vibration isolated wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- B. 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.
- C. Drilled-In Anchors:
1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the Structural Engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 4. 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.
- D. Riser Isolation: Suspended risers with spring hangers or supported with spring mounts, anchored with piping anchors, and guided with sliding guides.
1. Suspend horizontal pipe runs and branches with spring hangers for the first three supports from the risers.
 2. Steel springs shall be selected to provide a minimum of 3/4-inch static deflection except in those expansion locations where additional deflection is required to limit load changes to +25% of the initial load.

- E. Short-Circuiting: Avoid short-circuiting to the building any vibration-isolated piece of equipment, pipe, duct or other component. Short-circuits with or via rigid conduits, drain lines, rigid braces, rigid sleeves, framing, etc., shall all be avoided. The Contractor shall oversee trades to prevent the short-circuiting of any vibration isolation system and shall bring any unresolved conflicts to the Architect's attention.
- F. Incidentals: Supply and install any incidental equipment or parts needed to meet the requirements stated, even if not specified or shown on the drawings.

3.4 ADJUSTING

- A. Adjust isolators after piping system is at operating weight and temperature.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Engage a factory-authorized representative to inspect the completed installation prior to the closing in of any unfinished work and again at the completion of the project. Complete any corrective work identified during the inspection.
- C. Tests and Inspections:
 - 1. Measure isolator restraint clearance.
 - 2. Measure isolator deflection.
 - 3. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

Edition 0909-0416

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SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING & EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.

1.2 SUBMITTAL

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

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multi-layer, multi-color plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: Black.
 - 3. Background Color: White.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160°F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2" x 3/4".
 - 6. Minimum Letter Size: 1/2 inch. Include secondary lettering 3/8 inch.
 - 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's drawing designation or unique equipment number, and area(s) served by equipment. Coordinate with the Owner.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multi-layer, multi-color plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Red.
- D. Maximum Temperature: Able to withstand temperatures up to 160°F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2" x 3/4".

- F. Minimum Letter Size: 1/2 inch. Include secondary lettering 3/8 inch.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: As indicated on the drawings or required by the local authority.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
 - 1. Complying with latest edition of ANSI/ASME A13.1 unless specifically noted otherwise or directed by the Owner.
- B. Pretensioned Pipe Labels: Precoiled, semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Strap-On Pipe Labels: Semi-rigid plastic formed to fit circumference of pipe and to attach to pipe with stainless-steel worm-drive clamps.
- D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent adhesive backing.
- E. Pipe Label Contents: Include identification of piping service using the same designations or abbreviations as used on the 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 PAINTED PIPE AND DUCT LABELS

- A. Paint: Alkyd paint selected for use without a primer based on base material.
- B. Color: Match background color indicated in Label Color Schedules below.
- C. Application: Use stencils for paint application.
- D. Lettering Size: At least 3 inches high.
- E. Flow Arrows: To show flow direction.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Comply with requirements in latest edition of ANSI/ASME 13.1 unless noted otherwise.
- B. 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 20 feet along each run. Reduce intervals to 10 feet in areas of congested piping and equipment. Reduce spacing to 5 feet when required by code.
 - 7. Spaced at maximum 10 feet on piping above removable acoustical ceilings. Reduce spacing to 5 feet when required by code.
- C. Use painted pipe labels outside where piping is exposed to weather.
 - 1. Apply one or two coats using the same stencil as required for thorough coverage.
- D. Pipe Label Color Schedule:
 - 1. Condensate Drain Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.
 - 2. Refrigerant Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.

3.4 ADJUSTING AND CLEANING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.
- B. Clean faces of mechanical identification devices.

END OF SECTION

Edition 0605-0216

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SECTION 23 05 93

TESTING, ADJUSTING & BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes:
 - 1. Balancing Air Systems.
 - 2. Balancing HVAC Equipment.

1.2 APPROVED CONTRACTORS

- A. The City of Chandler will contract directly with one of the following:
 - 1. Able Balance, LLC.
 - 2. ABM Building Services, LLC., Phoenix, Arizona Balance Division.
 - 3. Arizona Air Balance Co.
 - 4. ETB Arizona.
 - 5. Phoenix Test and Balance, LLC.
 - 6. Precision Air.
 - 7. Southwest Testing and Balancing, LLC.
 - 8. Systems Commissioning & Testing, Inc.
 - 9. TAB Technology, Inc.
 - 10. Technical Air Balance.

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TAB Specialist: An entity engaged to perform TAB work.

1.4 SUBMITTALS

- A. Contractor Qualifications: Include AABC or NEBB certificates for proposed personnel, test instrument certifications.
- B. Certified TAB reports.
- C. Sealed special inspection reports.
- D. Submit a field copy of the balance report to the owner immediately upon completion of work.

1.5 QUALITY ASSURANCE

- A. Supervising technicians and firm shall be AABC or NEBB certified.

- 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 TAB plan and the procedures specified and referenced in this Specification.
- C. TAB Report Forms: Use standard TAB Contractor's forms.
- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, Instrumentation.
- E. Perform special inspections as required herein and by the AHJ.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents and approved submittals for the HVAC systems and equipment to become familiar with project requirements and to discover conditions in system designs that may preclude proper TAB of systems and equipment or inefficient operation. Report findings and recommendations directly to the Engineer within 30 days of document review.
- B. Examine ceiling plenums used for return or relief air to verify that there is a proper path for return and relief air from all areas of the building. Verify that penetrations through walls between plenum and non-plenum areas are sealed.
- C. Examine equipment performance data including fan curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- D. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, filters are clean and in place, and equipment with functioning controls is ready for operation.
- E. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- F. Examine operating safety interlocks and controls on HVAC equipment.
- G. Report deficiencies discovered before and during performance of TAB procedures directly to the Engineer and Mechanical Contractor. Observe and record system reactions to changes in conditions. Record default setpoints if different from indicated values.
- H. The General or Mechanical Contractor shall not in any way prohibit the TAB Contractor from communicating directly and freely with the Engineer. The TAB Contractor is required to copy the Engineer on all communications to the Contractor.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.

- B. Complete system-readiness checks and prepare reports. Verify the following:
1. Permanent electrical-power wiring is complete.
 2. Automatic temperature-control systems are operational.
 3. Equipment and duct access doors are securely closed.
 4. Balance, smoke, and fire dampers are open.
 5. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 6. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's National Standards for Total System Balance or NEBB's Procedural Standards for Testing Adjusting and Balancing of Environmental Systems, and in this section.
1. Comply with requirements in ASHRAE 62.1, Section 7.2.2, Air Balancing.
- B. Cut insulation and ducts for installation of test probes to the minimum extent necessary for TAB procedures.
1. After testing and balancing, patch probe holes in ducts airtight.
 2. Coordinate with the Mechanical Contractor to restore insulation, coverings, vapor barrier, and finish according to Division 23 sections.
- C. Mark equipment and balancing devices, including damper-control positions, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes. Correct variations that exceed $\pm 10\%$.
- B. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- C. 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.
- D. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- E. Verify that motor starters are equipped with properly sized thermal protection.
- F. Check dampers for proper position to achieve desired airflow path.
- G. Check for airflow blockages.
- H. Check condensate drains for proper connections.
- I. Check for proper sealing of air-handling-unit components.
- J. Verify that joints and seams in air duct systems are sealed as specified in Division 23 sections.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by the 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. Exception: Individual component measurement is not required for unitary equipment 5 tons and less in capacity. Provide external static pressure measurement across unit only.
 - 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. 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.
 - 7. Instruct the Mechanical Contractor to replace fan and motor sheaves and belts as required to achieve design airflow or pressurization.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
 - 1. Measure airflow of submain and branch ducts.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 - 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
 - 3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
 - 4. Instruct the Mechanical Contractor to install manual volume dampers where required to achieve proper air balance.

- C. Measure air outlets and inlets without making adjustments.
 - 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
 - 1. Adjust each outlet in the 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.

3.6 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer's name, model number, and serial number.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating.
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.
 - 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Set minimum motor speed to 20%. 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.

3.7 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.8 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each water coil:
 - 1. Entering- and leaving-water temperature.
 - 2. Waterflow rate.
 - 3. Water pressure drop.
 - 4. 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:
 - 1. Nameplate data.
 - 2. 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.
5. 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.
2. 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.

3.9 TOLERANCES

A. Set HVAC system's airflow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: $\pm 10\%$.
2. Air Outlets and Inlets: $\pm 10\%$.

3.10 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in the Examination article, prepare a report on the adequacy of design for system balancing devices. Recommend changes and additions to system 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.

3.11 OUTDOOR AIR SUMMARY REPORT

A. Prepare a summary report for review by the AHJ that lists each supply-air system on the project. The report shall indicate the system or equipment designation, the scheduled outdoor-airflow rate and the balanced outdoor-airflow rate.

3.12 SPECIAL INSPECTIONS

A. Prepare special inspection reports, signed and sealed by a professional engineer, as required by the AHJ or as required above.

3.13 FINAL REPORT

A. General: Prepare certified reports in both paper and PDF format; tabulate and divide the report into separate sections for tested systems and balanced systems. Submit three copies of paper reports and one copy of report in PDF format.

1. Assemble paper reports in 3-ring binders. Separate and order sections within each binder. Provide labeled tabs at each section with a table of contents at the front of the binder. The table of contents shall indicate the tab number and the information contained at that tab.

2. Assemble PDF report in one PDF file. Separate and order sections within the file to match the paper copy. Provide bookmarks at the first page of each section and label each bookmark with the information contained in that section. Submit on digital media acceptable to the Engineer.
- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Pump curves.
 2. Fan curves.
 3. 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.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB supervisor who certifies the report.
 10. Certification sheet signed and sealed by the certified Testing & Balancing Engineer.
 11. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 12. 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.
 13. Nomenclature sheets for each item of equipment.
 14. Data for terminal units, including manufacturer's name, type, size, and fittings.
 15. Notes to explain why certain final data in the body of reports vary from indicated values.
 16. 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. Variable frequency drive settings including maximum and minimum setpoints.
 - g. Inlet vane settings for variable-air-volume systems.
 - h. Settings for supply-air, static-pressure controller.
 - i. Other system operating conditions that affect performance.
 17. Include a list of instruments used for procedures, along with proof of calibration.
 18. Submit a preliminary, electronic copy of the final report to the Engineer for review.
 19. Make any corrections noted from the Engineer's review upon receipt of comments and resubmit as required.
 20. Submit the final, corrected report in electronic format to the Engineer and in both paper and electronic format to the Architect.

3.14 ADDITIONAL TESTS

- A. TAB Report Verification: The TAB Specialist may be required to recheck, in the presence of the Owner's representative, specific or random selections of data recorded in the certified report. Points and areas for recheck shall be selected by the Owner's representative. Measurements and test procedures shall be the same as approved for the initial work for the certified report. Selections for verification, specific plus random, will not exceed 10% of the total number of measurements tabulated in the report. If the values measured during the verification process exceed $\pm 10\%$ of the values recorded in the report, the TAB Specialist may be required to re-perform the TAB work outlined above.

END OF SECTION

Edition 0906-0422

SECTION 23 07 13

DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes duct exterior insulation systems.
- B. Related Sections:
 - 1. Refer to Specification Section 23 31 13, Metal Ducts, for duct liner.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated, include manufacturer's technical data with proposed thickness and R-value indicated, and application.

1.3 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E84, by a testing agency acceptable to the Authorities Having Jurisdiction (AHJ). Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in the Duct Insulation Schedule article 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 C871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.
- E. All materials shall conform to NFPA 90A and NFPA 90B, ASHRAE 90.1 and the International Energy Construction Code (IECC).
- F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C553, Type II and ASTM C1290, Type III with factory-applied FSK jacket composed of aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Bonded Logic Ultra-Touch.
- b. CertainTeed Corp.; SoftTouch Duct Wrap.
- c. Johns Manville; Microlite.
- d. Knauf Insulation; Atmosphere Duct Wrap.
- e. Manson Insulation Products Ltd.; Alley Wrap.
- f. Owens Corning; SOFTR All-Service Duct Wrap.

- H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C612, Type IA or Type IB with factory-applied ASJ or FSK jacket.

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
3. Products: Subject to compliance with requirements, provide one of the following:

- a. Bonded Logic Ultra-Touch.
- b. CertainTeed Corp.; Commercial Board.
- c. Johns Manville; 800 Series Spin-Glas.
- d. Knauf Insulation; Earthwool Insulation Board.
- e. Owens Corning; Fiberglas 700 Series.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- 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. 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. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below and above ambient services.
1. Water-Vapor Permeance: ASTM E96/E96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 2. Service Temperature Range: -20 to +180°F.
 3. Solids Content: ASTM D1644, 58% by volume and 70% by weight.
 4. Color: White.
- 2.4 SEALANTS
- A. FSK and Metal Jacket Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
 2. Fire- and water-resistant, flexible, elastomeric sealant.
 3. Service Temperature Range: -40 to +250°F.
 4. Color: Aluminum.
 5. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
 2. Fire- and water-resistant, flexible, elastomeric sealant.
 3. Service Temperature Range: -40 to +250°F.
 4. Color: White.
- 2.5 FIELD-APPLIED JACKETS
- A. Field-applied jackets shall comply with ASTM C921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Adhesive: As recommended by the jacket material manufacturer.
 2. Color: White.
- C. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
1. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size.
 2. Finish and thickness are indicated in field-applied jacket schedules.
 3. Moisture Barrier: 3-mil-thick, heat-bonded polyethylene and kraft paper or 2.5-mil-thick polysurlyn.
- D. Self-Adhesive Outdoor Jacket: 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with stucco-embossed aluminum-foil facing.

2.6 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
 - 1. Width: 3 inches.
 - 2. Thickness: 11.5 mils.
 - 3. Adhesion: 90 ounces force/inch in width.
 - 4. Elongation: 2%.
 - 5. Tensile Strength: 40 lbf/inch in width.
 - 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
 - 1. Width: 3 inches.
 - 2. Thickness: 6.5 mils.
 - 3. Adhesion: 90 ounces force/inch in width.
 - 4. Elongation: 2%.
 - 5. Tensile Strength: 40 lbf/inch in width.
 - 6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
 - 1. Width: 2 inches.
 - 2. Thickness: 6 mils.
 - 3. Adhesion: 64 ounces force/inch in width.
 - 4. Elongation: 500%.
 - 5. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
 - 1. Width: 2 inches.
 - 2. Thickness: 3.7 mils.
 - 3. Adhesion: 100 ounces force/inch in width.
 - 4. Elongation: 5%.
 - 5. Tensile Strength: 34 lbf/inch in width.

2.7 SECUREMENTS

- A. Aluminum Bands: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide, with wing seal or closed seal.
- B. Stainless-Steel Bands: 0.015 inch thick, 1/2 inch wide, with wing seal or closed seal.
- C. Insulation Pins and Hangers:
 - 1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030" thick x 2" square.

- b. Spindle: Copper- or zinc-coated, low carbon-steel, or stainless-steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - c. Adhesive: Recommended by the hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 - 2. Metal, Capacitor-Discharge-Weld Pin, Insulation Hangers: Copper-coated, low carbon-steel, or stainless-steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated. May be provided with base.
 - 3. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized or stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
 - 4. Metal, Cupped-Head, Capacitor-Discharge-Weld Pins:
 - a. Head: Galvanized, carbon-steel or stainless-steel sheet, minimum of 0.016 inch thick with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - b. Spindle: Copper- or zinc-coated, low carbon-steel, or stainless-steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - D. Staples: Outward-clinching insulation staples, nominal 3/4 inch wide, stainless steel or Monel.
 - E. Wire: 0.062-inch, soft-annealed stainless steel.
- 2.8 CORNER ANGLES
- A. PVC Corner Angles: 30 mils thick, minimum 1" x 1" PVC according to ASTM D1784, Class 16354-C. White or color-coded to match adjacent surface.
 - B. Aluminum Corner Angles: 0.040 inch thick, minimum 1" x 1" aluminum according to ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of 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 the 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 the 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 the 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 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75% 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 the same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends below roof surface. 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 inside building. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (that are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
 - 1. Comply with requirements in Division 07 specifications for firestopping and fire-resistive joint sealers.
- E. Insulation Installation at Floor Penetrations:
 - 1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 specifications.

3.4 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100% 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 adhesively attached or 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, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50°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 2 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 the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100% 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 adhesively attached or capacitor-discharge-weld pins and speed washers, or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.

- b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
- 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50°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 2 times the insulation thickness, but not less than 3 inches.
- 5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
- 6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.5 FIELD-APPLIED JACKET INSTALLATION

- A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
 - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by the insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.
 - 1. Cross-break or slope the top of all metal jackets mounted outside the building to promote drainage and to prevent ponding of water on top of the ductwork.

3.6 DUCT INSULATION SCHEDULE

- A. Duct, Plenums and Accessories Not Requiring Insulation:
 - 1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1. Refer to Specification Section 23 31 13, Metal Ducts, for duct lining requirements.

2. Factory-insulated flexible ducts.
3. Factory-insulated plenums and casings.
4. Flexible connectors.
5. Vibration-control devices.
6. Factory-insulated access panels and doors.

- B. Duct and Plenum Insulation: Insulate ducts and plenums in accordance with the Duct and Plenum Insulation Schedule Table.

DUCT & PLENUM INSULATION SCHEDULE TABLE					
Duct/Plenum System	Duct Type	Duct Location**	Insulation Type	Minimum Insulation Density (PCF)	Minimum Insulation R-Value (Thickness)
Supply (non-evaporative cooled)	Round	Interior, Concealed	Mineral-Fiber Blanket	0.75	R-6 (2 inches)
Supply (non-evaporative cooled)	Round	within Return Air Plenum	Mineral-Fiber Blanket	0.75	R-5 (1-1/2 inches)
Supply (non-evaporative cooled)	Rectangular	Interior, Concealed	Duct Lining*	--	--
Supply & Return (within room it serves)	Round	Interior, Exposed	None	--	--
Supply & Return (within room it serves)	Rectangular	Interior, Exposed	Duct Lining*	--	--
Supply & Return (within mechanical rooms)	Rectangular	Interior, Exposed	Duct Lining*	--	--
Return	Round	Interior, Concealed	Mineral-Fiber Blanket	0.75	R-6 (2 inches)
Return	Round	within Return Plenum	Mineral-Fiber Blanket	0.75	R-5 (1-1/2 inches)
Return & Exhaust	Rectangular	Interior, Concealed	Duct Lining*	--	--
Exhaust	Round	Interior, Concealed	None	--	--
Outside Air	Round/ Rectangular	Interior, Concealed or Exposed	Mineral-Fiber Blanket	0.75	R-8 (3 inches)
Supply & Return	Round/ Rectangular	Exterior, Concealed or Exposed	Duct Lining*	--	--
Outside Air	Round/ Rectangular	Exterior, Concealed	Mineral-Fiber Blanket	0.75	R-6 (2 inches)
* Refer to Specification Section 23 31 13, Metal Ducts, for liner requirements.					
** Interior means within the insulated building envelope. Exterior means outside the building envelope.					

3.7 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 the Contractor's option.
- C. Ducts and Plenums, Concealed: None.

3.8 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 the Contractor's option.
- C. Ducts and Plenums, Concealed: None.
- D. Ducts and Plenums, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
 - 1. Aluminum, Stucco Embossed: 0.020 inch thick.
- E. Ducts and Plenums, Exposed, Larger than 48 Inches in Diameter or with Flat Surfaces Larger than 72 Inches:
 - 1. Aluminum, Stucco Embossed with 1-1/4-Inch-Deep Corrugations: 0.040 inch thick.

END OF SECTION

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SECTION 23 07 19

HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes insulating the following HVAC piping systems:
 - 1. Refrigerant piping.
 - 2. Condensate drain piping.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated, include manufacturer's technical data with proposed thickness and R-value indicated, and application.

1.3 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E84, by a testing and inspecting agency acceptable to the Authorities Having Jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. All insulating materials shall conform to NFPA 90A and NFPA 90B, ASHRAE 90.1 and the International Energy Construction Code (IECC).
- 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 C871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.
- 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 C534, Type I for tubular materials.

1. Manufacturers: Subject to compliance with requirements, provide product by one of the following manufacturers:
 - a. Armacell LLC.
 - b. K-Flex USA

G. Mineral-Fiber Insulation:

1. Manufacturers: Subject to compliance with requirements, provide product by one of the following manufacturers:
 - a. CertainTeed Corp.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Manson Insulation Products Ltd.
 - e. Owens Corning.
2. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C1290, Type I.
3. Mineral-Fiber, Pre-Formed Pipe Insulation:
 - a. Type I, 850°F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547, Type I, Grade A, with factory-applied ASJ or with factory-applied ASJ-SSL. Omit jacket on all but outermost layer where multiple insulation layers are required. Jacket shall comply with the following:
 - 1) ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
 - 2) ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.

H. Removable Insulation Wrap:

1. Manufacturers: Subject to compliance with requirements, provide product by the following:
No Sweat.
2. Removable Insulation Wrap:
 - a. Insert: Mineral or glass fibers bonded with a thermosetting resin with a minimum K-factor of 0.26 suitable for use up to 450°F. Maximum flame spread index of 25 and maximum smoke developed index of 50 per ASTM E84. Insert thickness to match thickness of adjacent insulation.
 - b. Outer Jacket: Tychem wrap consisting of Tyvek fabric made of spunbonded polyolefin with a polyethylene coating to limit vapor permeability. Jacket shall be provided with elastic banding at the ends and a reclosable hook and loop closure system at the seam. Maximum flame spread index of 25 and maximum smoke developed index of 50 per ASTM E84.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.

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.

1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- D. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
- E. PVC Jacket Adhesive: Compatible with PVC jacket.

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
 1. Water-Vapor Permeance: ASTM E96/E96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 2. Service Temperature Range: -20 to +180°F.
 3. Solids Content: ASTM D1644, 58% by volume and 70% by weight.
 4. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
 1. Water-Vapor Permeance: ASTM F1249, 1.8 perms at 0.0625-inch dry film thickness.
 2. Service Temperature Range: -20 to +180°F.
 3. Solids Content: 60% by volume and 66% by weight.
 4. Color: White.

2.5 SEALANTS

- A. Joint Sealants:
 1. For indoor applications, use sealants that have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Permanently flexible, elastomeric sealant.
 4. Service Temperature Range: -100 to +300°F.
 5. Color: White or gray.
- B. Metal Jacket Flashing Sealants:
 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 2. Fire- and water-resistant, flexible, elastomeric sealant.
 3. Service Temperature Range: -40 to +250°F.
 4. Color: Aluminum.

C. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: -40 to +250°F.
4. Color: To match jacket.

2.6 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.

2.7 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C921, Type I, unless otherwise indicated.

- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Adhesive: As recommended by the jacket material manufacturer.
2. Color: White.
3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, traps, and mechanical joints.

- C. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

1. Sheet and roll stock ready for shop or field sizing, or factory cut and rolled to size.
2. Finish and thickness are indicated in field-applied jacket schedules.
3. Moisture Barrier for Indoor and Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
4. Factory-Fabricated Fitting Covers:
 - a. The same material, finish, and thickness as jacket.
 - b. Pre-formed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - c. Tee covers.
 - d. Flange and union covers.
 - e. End caps.
 - f. Beveled collars.
 - g. Valve covers.
 - h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

- D. Self-Adhesive Outdoor Jacket: 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with stucco-embossed aluminum-foil facing.

2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

1. Width: 3 inches.

2. Thickness: 11.5 mils.
 3. Adhesion: 90 ounces force/inch in width.
 4. Elongation: 2%.
 5. Tensile Strength: 40 lbf/inch in width.
 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Width: 2 inches.
 2. Thickness: 6 mils.
 3. Adhesion: 64 ounces force/inch in width.
 4. Elongation: 500%.
 5. Tensile Strength: 18 lbf/inch in width.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Width: 2 inches.
 2. Thickness: 3.7 mils.
 3. Adhesion: 100 ounces force/inch in width.
 4. Elongation: 5%.
 5. Tensile Strength: 34 lbf/inch in width.

2.9 SECUREMENTS

- A. Aluminum Bands: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.
- B. Staples: Outward-clinching insulation staples, nominal 3/4 inch wide, stainless steel or Monel.
- C. Wire: 0.062-inch, soft-annealed stainless steel.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Install insulation continuously through hangers and around anchor attachments.
- K. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
- L. 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.
- M. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. 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.
- N. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- O. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch-wide strips, of the same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- P. Cut insulation in a manner to avoid compressing insulation more than 75% of its nominal thickness.
- Q. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

- R. Repair damaged insulation facings by applying the same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- S. For above-ambient services, do not install insulation to the following:
 - 1. Items where insulation is prohibited by the manufacturer.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends below roof surface. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends inside building. 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 Division 07 specifications 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 specifications for firestopping and fire-resistive joint sealers.

G. Installation of Pipe Hangers and Rollers:

1. Install thermal-hanger shield inserts complying with Specification Section 23 05 29, Hangers and Supports for HVAC Piping and Equipment, at all hangers and rollers.

3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using pre-formed fitting insulation or mitered fittings made from the 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 pre-formed fitting insulation or sectional pipe insulation of the 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 pre-formed fitting insulation or sectional pipe insulation of the same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 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 pre-formed fitting insulation or sectional pipe insulation of the same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 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 pre-formed pipe insulation. Overlap adjoining pipe insulation by not less than 2 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.
10. Contractor's Option for Valves, Strainers and Coil Connection Kits: Removable insulation wrap system.

- a. Below Ambient Systems or Where a Vapor Barrier is Specified:
 - 1) Provide PVC tape around ends of wrap system to seal wrap to adjacent pipe insulation.
 - 2) Provide PVC tape closure along seam. Center tape to overlap seam.
- 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 and where required for maintenance. Installation shall conform to the following:
 - 1. Make removable flange and union insulation from sectional pipe insulation of the same thickness as that on adjoining pipe. Install the 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 at least 2 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 the same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 - 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 - 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 - 1. Install pipe insulation to outer diameter of pipe flange.
 - 2. Make width of insulation section the 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 the same thickness as pipe insulation.
 - 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
 - 1. Install mitered sections of pipe insulation.
 - 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install pre-formed valve covers manufactured of the same material as pipe insulation when available.
2. When pre-formed 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.

E. Insulation Installation on Flexible Bellow Connectors and Flexible Hoses:

1. Install full and mitered sections of pipe insulation as required.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 INSTALLATION OF MINERAL-FIBER PRE-FORMED PIPE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of pre-formed pipe insulation without jacket 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 the insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install pre-formed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section the 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 pre-formed sections of the same material as straight segments of pipe insulation when available.
2. When pre-formed 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 pre-formed sections of the same material as straight segments of pipe insulation when available.

2. When pre-formed 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; for horizontal applications. Seal with manufacturer's recommended adhesive.
 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal seams and end joints with weatherproof sealant recommended by the insulation manufacturer or if no sealant is recommended with silicone caulk. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.8 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable pre-formed 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 the Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on pre-insulated underground piping.

3.9 INDOOR PIPING INSULATION SCHEDULE

- A. Refrigerant Piping:
 1. Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Mineral-Fiber, Pre-Formed Pipe Insulation: 1 inch thick.
- B. Refrigerant Flexible Tubing: Flexible elastomeric, 1 inch thick.
- C. Air Conditioning Condensate Drain Piping: Flexible elastomeric, 3/4 inch thick.

3.10 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Refrigerant Piping: Flexible elastomeric, 1 inch thick.
- B. Refrigerant Flexible Tubing: Flexible elastomeric, 1 inch thick.
- C. Air Conditioning Condensate Drain Piping: Flexible elastomeric, 3/4 inch thick.

3.11 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 the Contractor's option or as directed on the drawings.
- C. Piping, Concealed: None.
- D. Piping, Exposed:
 - 1. PVC: 30 mils thick.

3.12 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 the Contractor's option.
- C. Piping, Concealed: None.
- D. Piping, Exposed:
 - 1. Aluminum, Corrugated or Stucco Embossed: 0.020 inch thick.

END OF SECTION

Edition 0908-0620

SECTION 23 08 00
COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes commissioning process requirements for HVAC systems, assemblies, and equipment.

1.2 DEFINITIONS

- A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- B. CxA: Commissioning Authority.
- C. HVAC: Heating, Ventilating, Air Conditioning.
- D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.3 INFORMATIONAL SUBMITTALS

- A. Certificates of readiness.
- B. Certificates of completion of installation, pre-start, and startup activities.

1.4 UNIT PRICES

- A. Commissioning testing allowance may be adjusted up or down by the List of Unit Prices in Division 01 specifications, when actual man-hours are computed at the end of commissioning testing.

1.5 CONTRACTOR'S RESPONSIBILITIES

- A. Perform commissioning tests at the direction of the CxA.
- B. Attend construction phase controls coordination meeting.
- C. Attend testing, adjusting, and balancing review and coordination meeting.
- D. Participate in HVAC systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
- E. Provide information requested by the CxA for final commissioning documentation.
- F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.6 CXA'S RESPONSIBILITIES

- A. Provide project-specific construction checklists and commissioning process test procedures for actual HVAC systems, assemblies, equipment, and components to be furnished and installed as part of the Construction Contract.
- B. Direct commissioning testing.
- C. Verify testing, adjusting, and balancing of work are complete.
- D. Provide test data, inspection reports, and certificates in systems manual.

1.7 COMMISSIONING DOCUMENTATION

- A. Provide the following information to the CxA for inclusion in the commissioning plan:
 - 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
 - 2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
 - 3. Process and schedule for completing construction checklists and manufacturer's pre-start and startup checklists for HVAC systems, assemblies, equipment, and components to be verified and tested.
 - 4. Certificate of readiness, signed by the Contractor, certifying that HVAC systems, assemblies, equipment, components, and associated controls are ready for testing.
 - 5. Certificate of completion certifying that installation, pre-start checks, and startup procedures have been completed.
 - 6. Certificate of readiness certifying that HVAC systems, subsystems, equipment, and associated controls are ready for testing.
 - 7. Test and inspection reports and certificates.
 - 8. Corrective action documents.
 - 9. Verification of Testing, Adjusting, and Balancing Reports.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

- A. Certify that HVAC systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify that HVAC instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pre-test setpoints have been recorded.
- C. Certify that testing, adjusting, and balancing procedures have been completed and that Testing, Adjusting, and Balancing Reports have been submitted, discrepancies corrected, and corrective work approved.
- D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

- E. Observe and verify the position of each device and interlock identified on checklists.
- F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
- G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.2 TESTING AND BALANCING VERIFICATION

- A. Prior to performance of testing and balancing work, provide copies of reports, sample forms, checklists, and certificates to the CxA.
- B. Notify the CxA at least 10 days in advance of testing and balancing work, and provide access for the CxA to witness testing and balancing work.
- C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC systems at the direction of the CxA.
 - 1. The CxA will notify the Testing & Balancing (TAB) Contractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
 - 2. The TAB Contractor shall use the same instruments (by model and serial number) that were used when original data was collected.
 - 3. Failure of an item includes, other than sound, a deviation of more than 10%. Failure of more than 10% of selected items shall result in rejection of final Testing, Adjusting, and Balancing Report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
 - 4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- B. Scope of HVAC testing shall include entire HVAC installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.
- C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- D. The CxA, along with the HVAC Contractor, TAB Contractor, and Building Automation System (BAS) Contractor, shall prepare detailed testing plans, procedures, and checklists for HVAC systems, subsystems, and equipment.
- E. Tests will be performed using design conditions whenever possible.
- F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- G. The CxA may direct that setpoints be altered when simulating conditions is not practical.

- H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering setpoints are not practical.
- I. If tests cannot be completed because of a deficiency outside the scope of the HVAC system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.4 HVAC SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

- A. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in HVAC piping sections. The HVAC Contractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:
 - 1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
 - 2. Description of equipment for flushing operations.
 - 3. Minimum flushing water velocity.
 - 4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.
- B. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of chillers, cooling towers, refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.
- C. HVAC Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC terminal equipment and unitary equipment.
- D. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.

END OF SECTION

Edition 0310-1115

SECTION 23 23 00
REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes refrigerant piping used for air-conditioning applications.
- B. Refrigerant type shall be consistent with refrigeration equipment specified in other sections.
- C. Refrigerant piping indicated on the drawings is schematic and intended to show the routing of the piping only.

1.2 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-22:
 - 1. Suction Lines for Air-Conditioning Applications: 185 psig.
 - 2. Suction Lines for Heat-Pump Applications: 325 psig.
 - 3. Hot-Gas and Liquid Lines: 325 psig.
- B. Line Test Pressure for Refrigerant R-407c:
 - 1. Suction Lines for Air-Conditioning Applications: 185 psig.
 - 2. Suction Lines for Heat-Pump Applications: 325 psig.
 - 3. Hot-Gas and Liquid Lines: 325 psig.
- C. Line Test Pressure for Refrigerant R-410a:
 - 1. Suction Lines for Air-Conditioning Applications: 300 psig.
 - 2. Suction Lines for Heat-Pump Applications: 525 psig.
 - 3. Hot-Gas and Liquid Lines: 525 psig.

1.3 SUBMITTALS

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop based on manufacturer's test data for thermostatic expansion valves, solenoid valves, and pressure-regulating valves.
- B. Pipe Sizing Guidelines: Equipment manufacturer's guidelines for layout and sizing of refrigerant piping.
- C. Shop Drawings: The Contractor is required to submit an isometric piping layout with each condensing unit submittal showing the detailed refrigerant piping layout. This refrigerant pipe layout is to include the following:
 - 1. System identification.
 - 2. All components, accessories, specialties, lengths, and elevation difference between compressor and evaporator.
 - 3. Total equivalent length of the piping system.

4. Pipe sizing, oil traps, double risers, etc., required to ensure proper operation and compliance with warranties of the connected equipment.
 5. Refrigerant pipe layout, sizing and components must conform to standard engineering practice as recognized by ARI, the ASHRAE Refrigeration Handbook and the equipment manufacturer's written recommendations.
- D. Field quality-control test reports.
 - E. Operation and maintenance data.
- 1.4 QUALITY ASSURANCE
- A. Comply with ASHRAE 15, Safety Code for Refrigeration Systems.
 - B. Comply with ASME B31.5, Refrigeration Piping and Heat Transfer Components.
- 1.5 PRODUCT STORAGE AND HANDLING
- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

- 2.1 COPPER TUBE AND FITTINGS
- A. Copper Tube: ASTM B88, Type K or L or ASTM B280, Type ACR.
 - B. Wrought-Copper Fittings: ASME B16.22.
 1. Elbows shall be long radius type.
 - C. Wrought-Copper Unions: ASME B16.22.
 - D. Brazing Filler Metals:
 1. Copper-to-Copper Joints: BCuP-5 or BCuP-6 without flux.
 2. Copper-to-Steel or Brass Joints: BAg-28 with non-acid flux.
 - E. Flexible Connectors:
 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
 2. End Connections: Socket ends.
 3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
 4. Pressure Rating: Factory test at minimum 500 psig.
 5. Maximum Operating Temperature: 250°F.

2.2 VALVES

A. Diaphragm Packless Valves:

1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
3. Operator: Rising stem and hand wheel.
4. Seat: Nylon.
5. End Connections: Socket, union, or flanged.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275°F.

B. Packed-Angle Valves:

1. Body and Bonnet: Forged brass or cast bronze.
2. Packing: Molded stem, back-seating, and replaceable under pressure.
3. Operator: Rising stem.
4. Seat: Non-rotating, self-aligning polytetrafluoroethylene.
5. Seal Cap: Forged-brass or valox hex cap.
6. End Connections: Socket, union, threaded, or flanged.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 275°F.

C. Packed Ball Valves:

1. Body: Two-piece, forged brass.
2. Extensions: Copper tubing.
3. Bonnet: Brass.
4. Stem Seals: Neoprene.
5. Ball: Chrome-plated brass.
6. Seals: Teflon.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 300°F.

D. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig.

E. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by a nationally recognized testing laboratory (NRTL).

1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24 VAC coil.
6. Working Pressure Rating: 400 psig.
7. Maximum Operating Temperature: 240°F.

2.3 REFRIGERANT PIPING SPECIALTIES

A. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color-coded to show moisture content in ppm.
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 240°F.

B. Replaceable-Core Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina or charcoal.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 240°F.

C. Permanent Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina or charcoal.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 240°F.

2.4 ACCUMULATORS

A. Liquid Accumulators 6-Inch Diameter and Smaller: Comply with ARI 495; listed and labeled by an NRTL.

1. Body: Brazed steel with corrosion-resistant coating.
2. Connections: Socket or threaded for inlet, outlet and pressure relief valve.
3. Working Pressure Rating: 400 psig.
4. Maximum Operating Temperature: 275°F.

2.5 HANGERS AND SUPPORTS

A. Pipe and Tubing Isolation Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. B-Line Systems.
 - b. Elgen.
 - c. Grinnell.
 - d. Hydra-Zorb.
 - e. Kin-Line.
 - f. Michigan Hanger Co.
 - g. National Pipe Hanger Corp.
 - h. PHD Manufacturing.
 - i. PHS Industries.
 - j. Pipe Technology and Products.
 - k. Unistrut.
2. Material: Oil, fuel, solvent, resistant thermoplastic elastomer. UL Listed for installation in return air plenums with a flame spread rating of 25 or less and a smoke development rating of 50 or less.
3. Design: Slit insert, designed for use with strut clamps to prevent metal-to-metal contact, reduce vibration transmission, and to securely hold pipe or tubing in position.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Aboveground Refrigerant Lines:

1. NPS 1-1/2 and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints or refrigerant line kits.
2. NPS 4: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

B. Belowground Refrigerant Piping: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints. No joints below ground.

C. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, K, or L (B) drawn-temper tubing and wrought-copper fittings with soldered joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Except as otherwise indicated, install diaphragm packless, packed-angle, or packed ball valves on inlet and outlet side of filter dryers.

B. Install thermostatic expansion valves as close as possible to distributors on evaporators.

1. Install valve so diaphragm case is warmer than bulb.
2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

- C. Install safety relief valves where required by the ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- D. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- E. Install filter dryers in liquid line between compressor and thermostatic expansion valve.

3.3 PIPING INSTALLATION

- A. Drawing plans indicate general location and arrangement of piping systems. Install piping as indicated on the approved shop drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- 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 adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 specifications if valves or equipment requiring maintenance are concealed behind finished surfaces.
- L. Install refrigerant piping in Schedule 40 PVC protective conduit where installed belowground. Size conduit to allow replacement of largest refrigerant pipe. Vent conduit to outdoors.
- M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- N. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps and double risers to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.

- O. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- P. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- Q. Identify refrigerant piping and valves according to Specification Section 23 05 53, Identification for HVAC Piping and Equipment.
- R. Install sleeves for piping penetrations of walls, ceilings, and floors.
- S. Install sleeve seals for piping penetrations of concrete walls and slabs.
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.4 PIPE JOINT CONSTRUCTION

- A. Brazed Joints: Construct joints according to AWS Brazing Handbook, Chapter 35, Pipe and Tubing.
 - 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 - 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.
- B. Flow nitrogen or carbon dioxide through pipe and fittings during brazing to prevent scale formation.

3.5 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor products are specified in Specification Section 23 05 29, Hangers and Supports for HVAC Piping and Equipment.
- B. Install the following pipe attachments:
 - 1. Provide trapeze hangers for multiple, parallel runs.
 - 2. Secure pipe to strut supports with pipe clamps or single-piece pipe straps
 - 3. Provide pipe and tube isolation device at each clamp and support.
- C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

	Maximum Span	Minimum Rod Size
NPS 1/2	60 inches	1/4 inch
NPS 5/8	60 inches	1/4 inch
NPS 1	72 inches	1/4 inch
NPS 1-1/4	96 inches	3/8 inch
NPS 1-1/2	96 inches	3/8 inch
NPS 2	96 inches	3/8 inch
NPS 2-1/2	108 inches	3/8 inch
NPS 3	10 feet	3/8 inch
NPS 4	10 feet	1/2 inch

- D. Support multi-floor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. Comply with ASME B31.5, Chapter VI.
 - 2. Test refrigerant piping and specialties. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
 - 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1, Performance Requirements article or as required by the Authorities Having Jurisdiction.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.7 SYSTEM CHARGING

- A. Charge system using the following procedures:
 - 1. Install core in filter dryers after leak test but before evacuation.
 - 2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
 - 3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
 - 4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust setpoint temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
 - 1. Open shutoff valves in condenser water circuit.
 - 2. Verify that compressor oil level is correct.
 - 3. Open compressor suction and discharge valves.
 - 4. Open refrigerant valves except bypass valves that are used for other purposes.
 - 5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION

Edition 0308-1018

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SECTION 23 31 13

METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes:
 - 1. Rectangular rigid ducts and fittings.
 - 2. Round rigid ducts and fittings.
 - 3. Sheet metal materials.
 - 4. Duct liner.
 - 5. Sealants and gaskets.
 - 6. Hangers and supports.

1.2 PERFORMANCE REQUIREMENTS

- A. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Provide the following for each duct application and pressure classification: Metal gauge, construction methods, reinforcement details and spacing, hangers and support details, seam and joint types. Include manufacturer, description of material, locations for use, R-value, and thickness for duct liner.
- C. Welding certificates.

1.4 QUALITY ASSURANCE

- A. 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 D9.1M/D9.1, Sheet Metal Welding Code, for duct joint and seam welding.

PART 2 - PRODUCTS

2.1 RECTANGULAR RIGID DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition, based on indicated static-pressure class unless otherwise indicated.
- B. Duct sizes shown on the drawings are clear, inside dimensions. Adjust sizes of sheet metal ductwork to account for duct lining.

- C. Exterior Ductwork: Cross-break or slope the top of all ductwork mounted outside the building to promote drainage and prevent water from ponding on the top of the ductwork.
- D. Transverse Joints: Fabricate according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition, Figure 2-1, Transverse (Girth) Joints, or manufacturer's instructions 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, 3rd Edition. Select joint types from the following:
1. Flat Drive Slip, T-1, T-3.
 2. Standing Drive Slip, T-2.
 3. Hemmed "S" Slip, T-6.
 4. Companion, Angle-Van Stone Type, T-22, T-22 Alternate.
 5. Flanged, formed, T-24, T-24 Alternate, or one of the following manufactured products:
 - a. Ductmate or WDCI by Ductmate Industries, Inc.
 - b. Elgen- or J-Flange by Elgen Manufacturing.
 - c. FLG J or H by Ward Industries; a Division of Hart & Cooley, Inc.
 - d. J Flange by CL Ward & Family, Inc.
 - e. J Flange by Nexus PDQ; Division of Shilco Holdings Inc.
- E. Longitudinal Seams: Fabricate according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition, Figure 2-2, Longitudinal Seams - Rectangular Ducts, 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, 3rd Edition. Select seam type based on the following:
1. Duct with Static Pressure 2-Inch wg and Less: Pittsburgh lock hammered flat, L-1, or button punch snap lock, L-2. Do not use button punch snap lock on aluminum duct.
 2. Duct with Static Pressure Greater than 2-Inch wg: Pittsburgh lock hammered flat, L-1.
- F. Elbows: Fabricate according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition, Figure 4-2, Rectangular Elbows. Comply with requirements for indicated static-pressure class, sealing requirements, support intervals, and other provisions in SMACNA's HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition. Select elbows from the following types:
1. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 2. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 3. Mitered Type RE 2 with single thickness turning 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.
- G. Branches: Fabricate according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition, Figure 4-5, Divided Flow Branches and Figure 4-6, Branch Connections. Comply with requirements for indicated static-pressure class, sealing requirements, support intervals, and other provisions in SMACNA's HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition. Select branch connections from the following types:
1. Rectangular Main to Rectangular Branch: 45-degree entry.
 2. Rectangular Main to Round Branch: Conical or 45-degree lead in.

- H. Transitions, Offsets, and Other Duct Construction: Select types and fabricate according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition, 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, 3rd Edition.

2.2 ROUND RIGID 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 sizes shown on the drawings are clear, inside dimensions. Adjust sizes of sheet metal ductwork to account for duct lining.
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition, Figure 3-1, Transverse Joints - Round Duct, 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, 3rd Edition.
 - 1. Transverse Joints in Ducts Larger than 60 Inches in Diameter: Flanged or the following manufactured products:
 - a. SpiralFlange by CL Ward & Family, Inc.
- D. Spiral Seams: Provide spiral seam ductwork using seam RL-1 and fabricate according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible, Figure 3-2, Round Duct Longitudinal Seams, for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition.
 - 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
- E. Elbows: Fabricate according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition, Figure 3-4, Round Duct Elbows. Comply with requirements for indicated static-pressure class, sealing requirements, support intervals, and other provisions in SMACNA's HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition.
 - 1. Minimum Radius-to-Diameter Ratio shall be 1.5.
 - 2. Elbow Segments: Comply with SMACNA's HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition, Table 3-1, Mitered Elbows. Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 3. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - 4. Round Elbows, 14 Inches and Larger in Diameter: Welded.
- F. Tees and Laterals: Fabricate according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition, Figure 3-5, 90 Degree Tees and Laterals, and Figure 3-6, Conical Tees. Comply with requirements for indicated static-pressure class, sealing requirements, support intervals, and other provisions in SMACNA's HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition. Select tees and laterals based on the following:
 - 1. Velocity up to 1,500 fpm: Conical tap.
 - 2. Velocity 1,500 fpm or Higher: 45-degree lateral.

3. Conical saddle taps may be used in existing duct.

2.3 PRODUCT CONVEYING DUCTWORK

- A. General Fabrication Requirements: Comply with SMACNA's Round Industrial Duct Construction Standards based on indicated static-pressure class unless otherwise indicated.
- B. Duct sizes shown on the drawings are clear, inside dimensions.
- C. Transverse Joints: Joints shall be air- and liquid-tight. Joints may be welded, soldered, flanged with gaskets, or clamped with gaskets.
- D. Longitudinal Seams: Seams shall be air- and liquid-tight. Seams may be welded, soldered or sealed with sealant compatible with the chemicals used in the system. Sealant shall be integral to the seam. Field-applied sealant is not allowed.
- E. Elbows: Fabricate according to SMACNA's Round Industrial Duct Construction Standards. Comply with requirements for indicated static-pressure class, sealing requirements, support intervals, and other provisions.
 1. Minimum Radius-to-Diameter Ratio shall be 1.5.
 2. Elbow Segments: Comply with SMACNA's Round Industrial Duct Construction Standards. Elbows with less than 90-degree change of direction have proportionately fewer segments.
 3. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or welded.
 4. Round Elbows, 14 Inches and Larger in Diameter: Welded.
- F. Tees and Laterals: Fabricate according to SMACNA's Round Industrial Duct Construction Standards. Comply with requirements for indicated static-pressure class, sealing requirements, support intervals, and other provisions in SMACNA's Round Industrial Duct Construction Standards. Select tees and laterals based on the following:
 1. Velocity up to 1,500 fpm: Conical tap.
 2. Velocity 1,500 fpm or Higher: 45-degree lateral.
 3. Conical saddle taps may be used in existing duct.

2.4 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 A653/A653M.
 1. Galvanized Coating Designation: G90.
 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Stainless-Steel Sheets: Comply with ASTM A480/A480M, Type 304 or 316, as indicated in the Duct Schedule article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the Duct Schedule article.
- D. Aluminum Sheets: Comply with ASTM B209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

- E. Reinforcement Shapes and Plates: ASTM A36/A36M, 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.
- F. Tie Rods: Galvanized steel, stainless steel, or aluminum to match duct material, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.5 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, Fibrous Glass Duct Liner Standard.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation; Insulation Group.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Owens Corning.
 - 2. Maximum Thermal Conductivity: Type I, Flexible: 0.27 Btu x in./h x sq.ft. x degrees F at 75°F mean temperature.
 - 3. Anti-Microbial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture-repellent and erosion-resistant coating. Anti-microbial compound shall be tested for efficacy by a nationally recognized testing laboratory (NRTL) and registered by the EPA for use in HVAC systems.
- B. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C916.
 - 1. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Mechanical Fasteners:
 - 1. Metal, Capacitor-Discharge-Weld Pin, Insulation Hangers: Copper-coated, low carbon steel, or stainless steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated. May be provided with base.
 - 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized or stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - 3. Metal, Cupped-Head, Capacitor-Discharge-Weld Pins:
 - a. Head: Galvanized, carbon-steel or stainless-steel sheet, minimum of 0.016 inch thick with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - b. Spindle: Copper- or zinc-coated, low carbon steel, or stainless-steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
- D. Shop Application of Fibrous-Glass Duct Liner in Rectangular Ducts: Comply with SMACNA's HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition, Figure 7-11, Flexible Duct Liner Installation.

1. Duct sizes shown on the drawings are clear, inside dimensions. Adjust sizes of sheet metal ductwork to account for duct lining.
2. Adhere a single layer of indicated thickness of duct liner with at least 90% adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
3. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
4. Butt transverse joints without gaps, and coat joint with adhesive.
5. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
6. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
7. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2,500 fpm.
8. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
9. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.
 - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2,500 fpm or where indicated.
10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

E. Shop Application of Fibrous-Glass Duct Liner in Round Ducts:

1. Duct sizes shown on the drawings are clear, inside dimensions. Adjust sizes of sheet metal ductwork to account for duct lining.
2. Follow liner manufacturer's written instructions.
 - a. Apply adhesive or other fastening devices in fittings or small duct sections as recommended.
 - b. Apply edge coating at all exposed edges without a factory coating.
 - c. Properly repair any tears, rips, or damaged areas as recommended.

2.6 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Polymer Joint and Seam Sealant:

1. Application Method: Pump applied during duct forming or assembly.
2. Solids Content: Minimum 90%.
3. Water resistant.
4. Mold and mildew resistant.
5. Non-skinning, non-drying.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.

7. Service: Indoor or outdoor.
8. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless-steel, or aluminum sheets.

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65%.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless-steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class 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.

2.7 HANGERS AND SUPPORTS

- A. Hanger Rods for Non-Corrosive 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, 3rd Edition, 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 A603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A492.
- 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 – GENERAL REQUIREMENTS

- 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.
- B. Install ducts according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition, unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, 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 the 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 Specification Section 23 33 00, Air Duct Accessories, for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris, dust, and other foreign materials. Comply with the "Advanced Level" of cleanliness as defined in SMACNA's Duct Cleanliness for New Construction Guidelines.
 - 1. This includes protecting the ductwork from dirt, debris and moisture, during transportation to the jobsite, prior to installation at the jobsite, and after installation.

3.2 EXPOSED DUCTWORK INSTALLATION – ADDITIONAL REQUIREMENTS

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Fabricate exposed ductwork with internal seam sealant.
- C. Construct joints with internal sealing elements.
- D. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- E. 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.
- F. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- G. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

- A. Seal ducts to the following seal classes according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible:
 - 1. All Ductwork: Seal Class A.
 - 2. All joints, wall penetrations, and seams to be externally sealed even if internal sealant is applied during duct forming and fabrication, except for exposed ductwork.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition, 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 and as directed by the Structural Engineer.
- C. Hanger Spacing: Comply with SMACNA's HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition, 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.

3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Specification Section 23 33 00, Air Duct Accessories.
- B. Comply with SMACNA's HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition and requirements herein for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

- A. Paint the inside of any ductwork including manual volume dampers that is visible through a grille, register, or diffuser with one coat of flat, black paint. Visible duct liner must have a black finish.

3.7 STARTUP

- A. Air Balance: Comply with requirements in Specification Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.

3.8 DUCT SCHEDULE

- A. Fabricate rigid ducts with galvanized sheet steel except as otherwise indicated and as follows:
 - 1. Underground Ducts: Concrete-encased, PVC-coated, galvanized sheet steel with thicker coating on duct exterior.
- B. Supply Ducts:
 - 1. Ducts Connected to Fan Coil Units, Furnaces, Air-Conditioners, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive 2-inch wg.
 - b. Minimum SMACNA Seal Class: Refer to Duct Sealing article.
 - c. SMACNA Leakage Class for Rectangular: 16.
 - d. SMACNA Leakage Class for Round and Flat Oval: 8.
- C. Return Ducts:
 - 1. Ducts Connected to Fan Coil Units, Furnaces, Air-Conditioners, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive or negative 1-inch wg.
 - b. Minimum SMACNA Seal Class: Refer to Duct Sealing article.
 - c. SMACNA Leakage Class for Rectangular: 16.
 - d. SMACNA Leakage Class for Round and Flat Oval: 8.
- D. Exhaust Ducts:
 - 1. Ducts Connected to Domestic Clothes Dryers:
 - a. Pressure Class: Positive 2-inch wg.
 - b. Minimum Duct Gauge: 26.

- c. Minimum SMACNA Seal Class: Refer to Duct Sealing article.
 - d. SMACNA Leakage Class for Round and Flat Oval: 8.
 - e. Elbows: Stamped or segmented only.
- E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
 - 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive or negative 1-inch wg.
 - b. Minimum SMACNA Seal Class: Refer to Duct Sealing article.
 - c. SMACNA Leakage Class for Rectangular: 16.
 - d. SMACNA Leakage Class for Round and Flat Oval: 8.
- F. Intermediate Reinforcement:
 - 1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.
 - 2. PVC-Coated Ducts:
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Match duct material.
 - 3. Stainless-Steel Ducts:
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Match duct material.
 - 4. Aluminum Ducts: Aluminum.
- G. Duct Liner: Furnish ducts with duct liner for the following applications unless noted otherwise on the drawings:
 - 1. Rectangular Supply and Return Air Ducts Within a Return Air Plenum or Within the Room It Serves: Fibrous glass, Type I, 1/2 inch thick with a minimum R-value of 2.
 - 2. Rectangular Supply and Return Air Ducts Within the Building Envelope: Fibrous glass, Type I, 1-1/2 inches thick with a minimum R-value of 6.
 - 3. Rectangular Supply and Return Air Ducts Outside the Building Envelope: Fibrous glass, Type I, 2 inches thick with a minimum R-value of 8.
 - 4. Rectangular Exhaust Air Ducts Within the Building Envelope: Fibrous glass, Type I, 1/2 inch thick.
 - 5. Supply and Return Fan Plenums Within the Building Envelope: Fibrous glass, Type II, 1-1/2 inches thick with a minimum R-value of 6.
 - 6. Supply and Return Fan Plenums Outside the Building Envelope: Fibrous glass, Type II, 2 inches thick with a minimum R-value of 8.
 - 7. Transfer Ducts: Fibrous glass, Type I, 1/2 inch thick.
 - 8. Exception: Do not line ductwork connected to evaporative coolers, ductwork connected to kitchen hoods, outside air intakes, ductwork serving shower areas, or combustion air ducts.

END OF SECTION

Edition 0307-0522

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SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes:
 - 1. Backdraft and pressure-relief dampers.
 - 2. Manual volume dampers.
 - 3. Control dampers.
 - 4. Flange connectors.
 - 5. Turning vanes.
 - 6. Duct-mounted access doors.
 - 7. Flexible connectors.
 - 8. Flexible ducts.

1.2 SUBMITTALS

- A. Product Data: Provide manufacturer's product data for each duct accessory intended for use on this project. Data to be specific to the items proposed for the project with all options and accessories indicated. Include the following as a minimum:
 - 1. Manufacturer and model number.
 - 2. Dimensions.
 - 3. Electrical data for damper motor operators including voltage and motor ampacity.
 - 4. Materials of construction.
 - 5. Accessories and options.
- B. Warranty information.
- C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- 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 AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. 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 A653/A653M.

1. Galvanized Coating Designation: G90.
 2. Exposed-Surface Finish: Mill phosphatized.
- C. Stainless-Steel Sheets: Comply with ASTM A480/A480M, Type 304, and having a No. 2 finish for concealed ducts and No. 4 finish for exposed ducts.
- D. Aluminum Sheets: Comply with ASTM B209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, one-side bright finish for exposed ducts.
- E. Extruded Aluminum: Comply with ASTM B221, Alloy 6063, Temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Air Balance Inc.
 2. Elgen Manufacturing.
 3. Greenheck Fan Corporation.
 4. McGill Airflow LLC.
 5. Metal Form.
 6. Nailor Industries Inc.
 7. National Controlled Air.
 8. Pottorff.
 9. Ruskin Company.
 10. Safe-Air-Dowco.
 11. Vent Products Company, Inc.
 12. Young Regulator Company.
- B. Backdraft and Pressure-Relief Dampers:
1. Description: Counterbalanced.
 2. Maximum Air Velocity: 2,000 fpm.
 3. Static Pressure Range: 0.01 to 0.10 inch wg.
 4. Frame: Hat-shaped, minimum 0.052-inch-thick, galvanized sheet steel, 0.063-inch-thick extruded aluminum or 0.052-inch-thick stainless steel, with welded corners and mounting flange.
 5. Blades: Multiple single-piece blades, maximum 6-inch-width, 0.025-inch-thick, roll-formed aluminum or 0.050-inch-thick aluminum sheet with sealed edges. Blade material shall match frame material.
 6. Blade Action: Parallel.
 7. Blade Seals: Extruded vinyl or neoprene mechanically locked.
 8. Blade Axles:
 - a. Material: Galvanized steel, stainless steel or aluminum to match frame and blades.
 - b. Diameter: Minimum 0.20 inch.
 9. Tie Bars and Brackets: Aluminum or galvanized steel to match axles.
 10. Bearings: Steel ball or synthetic pivot bushings.

11. Counterweights: Adjustable for varying differential static pressure as well as horizontal and vertical airflow.

C. Manual Volume Dampers:

1. Rectangular:

- a. Factory fabricated for shutoff or balancing duty in branch ducts:

- 1) Standard leakage rating, with linkage outside airstream.
 - 2) Suitable for horizontal or vertical applications.
 - 3) Frames:
 - a) Hat-shaped, galvanized-steel or aluminum channels.
 - b) Mitered and welded corners.
 - c) Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 4) Blades:
 - a) Multiple with maximum blade width of 8 inches.
 - b) Opposed-blade design.
 - c) Stiffen damper blades for stability.
 - d) Galvanized steel, 0.064 inch thick, or aluminum 0.10 inch thick to match frame.
 - 5) Blade Axles: Galvanized steel or aluminum to match frame and blades.
 - 6) Bearings:
 - a) Oil-impregnated bronze or molded synthetic.
 - b) Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 7) Tie Bars and Brackets: Galvanized steel or aluminum to match frame and blades.
 - 8) Jackshaft:
 - a) Size: 1-inch diameter.
 - b) Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 - c) Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
 - 9) Damper Hardware:
 - a) 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.
 - b) Include center hole to suit damper operating-rod size.
 - c) Include elevated platform for insulated duct mounting.

- b. Shop and field fabricated for balancing duty in duct runouts serving a single diffuser, grille, or register:
 - 1) Blade: Single blade volume damper constructed per SMACNA Standards.
 - 2) Handle: Stamped or cast metal configured to indicate damper position in duct. Provide extension to raise handle above duct insulation and locking device such as wing nut to secure extension device to side of damper bearing and duct, or standoff with locking quadrant to secure damper in position, similar to Ventlok 641 in uninsulated ducts, Ventlok 644 in insulated ducts, or Ventlok 555 with standoff in either.
- 2. Round:
 - a. Factory fabricated for shutoff or balancing duty in branch ducts:
 - 1) Standard leakage rating.
 - 2) Suitable for horizontal or vertical applications.
 - 3) Frames: Galvanized-steel channel.
 - 4) Blades: Galvanized steel, minimum 16 gauge.
 - 5) Blade Axles: Plated steel extending minimum 6 inches beyond frame.
 - 6) Bearings: Nylon sleeve with stainless-steel thrust washers.
 - 7) Stops: Plated screw for both open and closed positions.
 - 8) Damper Hardware:
 - a) 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.
 - b) Include center hole to suit damper operating-rod size.
 - c) Include elevated platform for insulated duct mounting.
 - d) Include locking quadrant to secure damper in position similar to Ventlok 555 or self-locking handle similar to Ventlok 641 in uninsulated ducts or Ventlok 644 in insulated ducts.
 - b. Shop and field fabricated for balancing duty in duct runouts serving a single diffuser, grille or register:
 - 1) Blade: Single blade volume damper constructed per SMACNA Standards.
 - 2) Stamped or cast metal configured to indicate damper position in duct. Provide extension to raise handle above duct insulation and locking device such as wing nut to secure extension device to side of damper bearing and duct, or standoff with locking quadrant to secure damper in position, similar to Ventlok 641 in uninsulated ducts, Ventlok 644 in insulated ducts, or Ventlok 555 with standoff in either.
- 3. Remote Damper Operators:
 - a. Damper operator for remote operation of manual balancing dampers located above hard ceilings or other inaccessible locations.
 - b. Electrically Activated: Greenheck RBD-10.
 - 1) Electrically actuated motor for field mounting on manual balancing damper shaft.
 - 2) Plenum-rated, interconnect cable in length suitable to reach remote wall, ceiling, or diffuser plate.
 - 3) Handheld, battery-powered controller for actuation of motor.

- c. Manually Activated: Young 270-315.
 - 1) Galvanized steel rack and pinion controller for attachment to the balancing damper shaft.
 - 2) Bowden cable with galvanized steel outer casing and stainless-steel inner wire in length as required but no more than 50 feet.
 - 3) Ceiling mounted, die-cast mounting cup, with adjustable threaded cover.
 - d. Provide all accessories required for the intended application.
- D. Control Dampers:
- 1. AMCA-rated.
 - 2. Rectangular:
 - a. Frames:
 - 1) Hat or U-channel.
 - 2) Galvanized steel, minimum 0.064 inch thick.
 - 3) Mitered and welded corners.
 - b. Blades:
 - 1) Airfoil shape.
 - 2) Multiple blade with maximum blade width of 8 inches and length of 48 inches.
 - 3) Opposed-blade design for throttling or on-off duty, parallel-blade design for on-off duty.
 - 4) Galvanized steel.
 - 5) 0.080 inch thick.
 - 6) Blade Edge Seals: Inflatable blade edging or replaceable rubber blade seals.
 - 7) Blade Jamb Seals: Flexible metal compression seal.
 - c. Blade Axles: 1/2-inch diameter; plated or galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings and thrust bearings at each end of every blade.
 - 1) Operating Temperature Range: From -40 to +200°F.
 - d. Bearings:
 - 1) Oil-impregnated bronze, stainless steel, or molded synthetic.
 - 2) Dampers in ducts with pressure classes of 3-inch w.g. or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 3) Thrust bearings at each end of every blade.
 - e. Leakage: Maximum of 3 cfm/sq.ft. at 1-inch wg.
 - 3. Round:
 - a. Frames: Galvanized steel, minimum 0.040 inch thick.
 - b. Blade: Two layers of galvanized steel, each a minimum 0.080 inch thick.
 - c. Blade Seal: Neoprene sandwiched between blade layers extending beyond blades all around.
 - d. Blade Axle: 1/2-inch diameter extended full length of blade; plated or galvanized steel extending beyond frame as required for operator mounting.

1) Maximum Operating Temperature: 200°F.

- e. Bearings: Oil-impregnated bronze, stainless steel, or molded synthetic.
- f. Leakage: Maximum of 0.15 cfm per inch of blade circumference at 1-inch w.g

2.3 TURNING VANES

- A. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades; set into vane runners suitable for duct mounting.
- B. General Requirements: Comply with SMACNA's HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition; Figures 4-3, Vanes and Vane Runners, and 4-4, Vane Support in Elbows.
- C. Vane Construction: Single thickness with 3/4-inch trailing edge spaced at 1-1/2-inch centers.

2.4 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - 1. American Warming and Ventilating.
 - 2. CL Ward & Family, Inc.
 - 3. Ductmate Industries, Inc.
 - 4. Flexmaster U.S.A., Inc.
 - 5. Greenheck.
 - 6. McGill AirFlow Corporation.
 - 7. Nailor Industries Inc.
 - 8. Ventfabrics, Inc.
 - 9. Ward Industries, Inc.; a Division of Hart & Cooley, Inc.
- B. Rectangular Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition; Figure 7-2, Duct Access Doors and Panels.
 - 1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Where used in product conveying ducts, match duct material.
 - c. Hinges and Latches: 1" x 1" 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. Where used in product conveying ducts, match duct material.
 - 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: Two hinges and two sash locks.
 - c. Access Doors up to 24 Inches by 48 Inches: Three hinges and two compression latches.
 - d. Access Doors Larger than 24 Inches by 48 Inches: Four hinges and two compression latches with outside and inside handles.

- C. Round Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition; Figure 7-3, Access Panels - Round Duct.

1. Door:
 - a. Double wall, rectangular or oval.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Where used in product conveying ducts, match duct material.
 - c. Hinges and Latches: 1" x 1" butt- or piano-hinge and cam latches.
 - d. Fabricate doors airtight and suitable for duct pressure class.
2. 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: Two hinges and two sash locks.
 - c. Access Doors up to 24 Inches by 48 Inches: Three hinges and two compression latches.

2.5 FLEXIBLE CONNECTORS

- 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. CL Ward & Family, Inc.
 2. Ductmate Industries, Inc.
 3. Duro Dyne Inc.
 4. Elgen.
 5. Ventfabrics, Inc.
 6. Ward Industries, Inc.; a Division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or non-combustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch-wide, 0.028-inch-thick galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric, double coated with neoprene.
1. Minimum Weight: 26 oz./sq.yd.
 2. Tensile Strength: 480 lbf./inch in the warp and 360 lbf./inch in the filling.
 3. Service Temperature: -40 to +200°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. Minimum Tensile Strength: 500 lbf./inch in the warp and 440 lbf./inch in the filling.
 3. Service Temperature: -50 to +250°F.

2.6 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Atco Flex.
 - 2. Elgen.
 - 3. Flexmaster U.S.A., Inc.
 - 4. Genflex.
 - 5. Manville.
 - 6. Owens-Corning.
 - 7. Therma Flex.
 - 8. Wiremold.
- B. Insulated, Flexible Duct: UL 181, Class 1, polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor-barrier film.
 - 1. Pressure Rating:
 - a. Low Pressure: 4-inch wg positive and 0.5-inch wg negative.
 - 2. Maximum Air Velocity: 4,000 fpm.
 - 3. Temperature Range: -20 to +175°F.
 - 4. Insulation R-Value: Comply with the latest edition of ASHRAE/ IESNA 90.1.
- C. Flexible Duct Connectors:
 - 1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Select duct accessories suitable for the pressure class of the ductwork to which it is attached.
- B. Install duct accessories according to applicable details in SMACNA's HVAC Duct Construction Standards - Metal and Flexible for metal ducts.
- C. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- D. Install turning vanes in all rectangular duct elbows having a 45-degree or greater bend as indicated.
- E. Install volume dampers at points on supply, return, and exhaust systems where branches serving diffusers and grilles extend from larger ducts. Install dampers where accessible and as close to mains as possible. Where dampers are installed in ducts having duct liner, install dampers with hat channels of the 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.

- F. Install volume dampers in outside-air systems at the connection to the equipment served.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- G. Install volume dampers where directed by the Test and Balance Contractor as required for proper system balancing.
- H. Remote Damper Operators:
 - 1. Install remote damper operators for all dampers located above hard ceilings or for dampers that will otherwise be inaccessible at the completion of construction.
 - 2. Install remote damper operator in accordance with the manufacturer's written instructions.
 - 3. Locate operator interface as indicated on the drawings or as instructed by the Architect/Engineer.
 - 4. Finish cover to match adjacent ceiling.
- I. Set dampers to fully open position before testing, adjusting, and balancing.
- J. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment. Locate on side of duct with greatest clearance. Install at the following locations:
 - 1. On both sides of duct coils. (Minimum head and hand access.)
 - 2. Upstream and downstream from duct filters. (Minimum head and hand access.)
 - 3. At outdoor-air intakes and mixed-air plenums. (Minimum head and hand access.)
 - 4. At drain pans and seals. (Minimum head and hand access.)
 - 5. Downstream from control dampers, backdraft dampers, and other duct-mounted equipment. (Minimum head and hand access.)
 - 6. Elsewhere as indicated.
- K. Install access doors with swing against duct static pressure.
- L. Minimum Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8" x 5".
 - 2. Two-Hand Access: 12" x 6".
 - 3. Head and Hand Access: 18" x 10".
 - 4. Head and Shoulders Access: 21" x 14".
 - 5. Body Access: 25" x 14".
 - 6. Body plus Ladder Access: 25" x 17".
- M. Label access doors according to Specification Section 23 05 53, Identification for HVAC Piping and Equipment, to indicate the purpose of access door.
- N. Install flexible connectors to connect ducts to equipment. Provide minimum 26 gauge sheet metal sunshields on flexible connectors exposed to weather.
- O. Install flexible connectors in duct crossing building expansion joints. Provide sheet metal sunshields on flexible connectors exposed to weather.
- P. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

Q. Flexible duct may only be used in the following locations with the following limitations:

1. Connect diffusers, grilles, or registers located in lay-in ceilings to ducts with maximum 60-inch lengths of low-pressure flexible duct secured in place with stainless-steel clamps.
2. Install flexible ducts stretched and supported without kinks or sags.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.

END OF SECTION

Edition 0307-0121

SECTION 23 34 23

HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes:

1. In-line centrifugal fans.

1.2 SUBMITTALS

- A. Product Data: Provide manufacturer's product data for each unit indicated on the drawings. Data to be specific to the equipment proposed for the project with all options and accessories indicated. Include the following as a minimum:

1. Manufacturer and model number.
2. Rated capacity based on scheduled conditions and project elevation.
3. Equipment dimensions and weights.
4. Required clearances.
5. Electrical Data:
 - a. Motor horsepower.
 - b. Voltage/Phase/Hz.
 - c. Electrical service point(s) of connection.
6. Materials of construction.
7. Accessories and options.
8. Controls.

- B. Warranty information.

- C. Operation and maintenance data.

1.3 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. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on the drawings or comparable product by one of the following:
1. Acme Engineering & Manufacturing Corporation.

2. CaptiveAire Systems.
3. Carnes Company.
4. Greenheck Fan Corporation.
5. Loren Cook Company.
6. PennBarry.
7. Twin City Fan & Blower.

2.2 IN-LINE CENTRIFUGAL FANS

- A. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.
- B. Direct-Drive Units: Motor mounted in airstream, with wheel, inlet cone.
- C. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing, drives shall be sized for 150% of installed motor horsepower. Bearings shall be regreasable ball type in pillow block housing with a minimum L10 life in excess of 40,000 hours.
- D. Fan Wheels: Aluminum, airfoil or backward-inclined blades welded to aluminum hub.
- E. Accessories:
 1. Variable-Speed Controller: Solid-state control to reduce speed from 100% to less than 50% for all direct-drive units.
 2. Companion Flanges: For inlet and outlet duct connections.
 3. Fan Guards: 1/2" x 1" mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
 4. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.
 5. Backdraft Damper: gravity.
 6. Disconnect Switch: NEMA 1, factory wired and located on outside of housing.
 7. Finish: Baked-epoxy powder coat.
- F. Capacities and Characteristics:
 1. Vibration Isolators:
 - a. Type: Elastomeric hangers.
 - b. Static Deflection: 1 inch.

2.3 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Specification Section 23 05 13, Common Motor Requirements for HVAC Equipment.
 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 sections.

2.4 SOURCE QUALITY CONTROL

- A. Certify sound-power level ratings according to AMCA 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data. Factory test fans according to AMCA 300, Reverberant Room Method for Sound Testing of Fans. Label fans with the AMCA-Certified Ratings Seal.
- B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating. Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 1 inch. Vibration-control devices are specified in Specification Section 23 05 48.13, Vibration Controls for HVAC Piping and Equipment.
- B. Install accessories according to the manufacturer's written instructions.
- C. Install units with clearances for service and maintenance.
- D. Label units according to requirements specified in Specification Section 23 05 53, Identification for HVAC Piping and Equipment.

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Specification Section 23 33 00, Air Duct Accessories.
- B. Install ducts adjacent to power ventilators to allow service and maintenance.

3.3 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Adjust belt tension.
 - 6. Adjust damper linkages for proper damper operation.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 - 9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 - 10. Shut unit down and reconnect automatic temperature-control operators.

11. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Comply with requirements in Specification Section 23 05 93, Testing, Adjusting, and Balancing for HVAC, for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

END OF SECTION

Edition 0608-0417

SECTION 23 37 13

DIFFUSERS, REGISTERS & GRILLES

PART 1 - GENERAL

1.1 SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
 - 1. Data Sheet: Indicate drawing designation, manufacturer, model number, materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, noise ratings, and accessories furnished.

PART 2 - PRODUCTS

2.1 DIFFUSERS, REGISTERS & GRILLES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on the drawings or comparable product by one of the following:
 - 1. Anemostat.
 - 2. Krueger.
 - 3. Nailor Industries, Inc.
 - 4. Price Industries.
 - 5. Titus.
 - 6. Tuttle & Bailey.
- B. Materials:
 - 1. Provide diffusers, registers, and grilles constructed of the materials indicated on the drawings.
 - 2. Diffusers, registers, and grilles mounted in damp or wet locations such as shower rooms, kitchen areas, or installed in evaporative cooler systems shall be all aluminum construction.
 - 3. Diffusers, registers, and grilles are to be factory finished unless noted otherwise. Provide color as scheduled or as directed by the Architect.
- C. Source Quality Control:
 - 1. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, Method of Testing for Rating the Performance of Air Outlets and Inlets.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.

- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. Where architectural features or other items conflict with installation, notify the 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, and fire dampers.
- D. Paint all interior ductwork visible through the diffuser, register, or grille flat black.

3.2 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

Edition 0306-721

SECTION 23 81 26

SPLIT-SYSTEM AIR CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.2 SUBMITTALS

- A. Product Data: Provide manufacturer's product data for each unit indicated on the drawings. Data to be specific to the equipment proposed for the project with all options and accessories indicated. Include the following as a minimum:

1. Manufacturer and model number.
2. Rated capacity based on scheduled conditions and project elevation.
3. Equipment dimensions and weights.
4. Required clearances.
5. Electrical Data:
 - a. Motor horsepower.
 - b. Voltage/Phase/Hz.
 - c. Full load ampacity, minimum circuit ampacity and maximum overcurrent protection device requirements.
 - d. Electrical service point(s) of connection.
 - e. AIC rating of the equipment.
6. Materials of construction.
7. Accessories and options.
8. Controls.

- B. Warranty information.

- C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- B. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, Safety Standard for Refrigeration Systems.
2. Applicable requirements in the latest edition of ASHRAE 62.1, Section 4 - Outdoor Air Quality, Section 5 - Systems and Equipment, Section 6 - Procedures, and Section 7 - Construction and System Start-Up.

- C. ASHRAE/IESNA Compliance: Applicable requirements in the latest edition of ASHRAE/IESNA 90.1.

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
1. Warranty Period:
 - a. For Compressor: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on the drawings or comparable product by one of the following:
1. Ductless Units:
 - a. Carrier Corporation.
 - b. Daikin.
 - c. Fujitsu General America, Inc.
 - d. Lennox International Inc.
 - e. LG Electronics.
 - f. Mitsubishi.
 - g. Panasonic Corporation.
 2. Ducted Units:
 - a. Carrier Corporation.
 - b. Daikin.
 - c. Fujitsu General America, Inc.
 - d. Lennox International Inc.
 - e. LG Electronics.
 - f. Trane; an American Standard company.
 - g. York; a Johnson Controls company.

2.2 DUCTLESS INDOOR UNITS

- A. Wall-Mounted and Ceiling-Suspended Evaporator-Fan Components:
1. Cabinet: Zinc-coated steel chassis with removable, white, enameled steel or plastic panels on front and ends, with rear outside air intake.
 2. Insulation: Faced, fiberglass duct liner.
 3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 210/240.
 4. Fan: Direct drive, centrifugal.
 5. Fan Motors: Open drip-proof, permanently lubricated ball bearing, multi-speed with overload protection.
 6. Disconnect: Provide unit-mounted disconnect switches (unless power is supplied from the outdoor unit).
 7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in the latest edition of ASHRAE 62.1.
 8. Filters: Provide filter rack with factory-supplied cleanable filter.

9. Condensate Drain Pans:

- a. Fabricated with slope to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and direct water toward drain connection.
- b. Provide condensate pump with overflow switch to shut off the unit in case of pump malfunction.

10. Air Discharge: Front discharge with horizontal air sweep.

2.3 DUCTED INDOOR UNITS (5 TONS OR LESS)

- A. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
- B. Insulation: Faced, glass-fiber duct liner.
- C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 210/240.
- D. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
- E. Fan Motors:
 1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Specification Section 23 05 13, Common Motor Requirements for HVAC Equipment.
 2. Multi-tapped, multi-speed with internal thermal protection and permanent lubrication.
 3. Wiring Terminations: Connect motor to chassis wiring with plug connection.
- F. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- G. Filters: Comply with NFPA 90A.
 1. Provide minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
 2. Provide filter holding frame for 1-inch-thick filter, arranged for flat orientation, with access door on side of unit.
 3. Comply with requirements of Division 23 sections.
 4. Provide filters as indicated on the drawings.
- H. Condensate Drain Pans:
 1. Fabricated with minimum 1% slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and to direct water toward drain connection.
 - a. Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
 - b. Depth: A minimum of 1 inch deep.
 2. Single-wall, stainless-steel sheet or plastic.
 3. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

4. Overflow Switch: Provide condensate overflow switch wired to shut off unit in case of condensate drain malfunction.

2.4 OUTDOOR UNITS (5 TONS OR LESS)

- A. Description: Factory assembled and tested, air cooled; consisting of casing, compressors, condenser coils, condenser fans and motors, and unit controls. Controls shall permit operation in cooling mode down to 25°F and heat pump operation down to 15°F.
- B. Casing: Steel, finished with baked enamel with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
- C. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 1. Compressor Type: Scroll or variable-speed scroll as indicated.
 2. Refrigerant Charge: R-407c or R-410A as scheduled.
 3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid sub-cooler. Comply with ARI 210/240.
- D. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
- E. Condenser Coil: Seamless copper-tube, aluminum-fin coil, including sub-cooling circuit and backseating liquid-line service access valve. Factory pressure test coils, then dehydrate by drawing a vacuum and fill with a holding charge of nitrogen or refrigerant.
- F. Fan: Aluminum propeller type, statically and dynamically balanced directly connected to motor.
- G. Motor: Totally enclosed permanently lubricated, with integral thermal-overload protection.

2.5 ACCESSORIES

- A. Thermostat: Low-voltage, wall-mounted, 7-day programmable type to control compressor and evaporator fan, with the following features:
 1. Compressor time delay.
 2. 24-hour time control of system stop and start.
 3. Liquid-crystal display indicating temperature, setpoint temperature, time setting, operating mode, and fan speed.
 4. Fan-speed selection including auto setting.
- B. Automatic-reset timer to prevent rapid cycling of compressor.
- C. Condenser coil hail guards to protect coil from damage.
- D. Field-Installed Hot-Gas Bypass Where Scheduled: Consisting of Rawall APR control valve installed to bypass hot refrigerant gas around the compressor. Install on first stage of cooling on units with multiple refrigerant circuits. Provide manual isolation valve on each side of APR.
- E. Low Ambient Kit: Required permits operation down to 10°F.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install ground-mounted, compressor-condenser components on 4-inch-thick, reinforced concrete base that is 4 inches larger, on each side, than unit. Concrete, reinforcement, and formwork are specified in Division 03 specifications. Coordinate anchor installation with concrete base.
- D. Install roof-mounted, compressor-condenser components on equipment supports installed in accordance with Division 07 specifications. Anchor units to supports with removable, cadmium-plated fasteners.

3.2 CONNECTIONS

- A. Install and connect refrigerant piping in accordance with Specification Section 23 23 00, Refrigerant Piping, to component's quick-connect fittings. Install piping to allow access to unit.
- B. Condensate Drainage Connections: Comply with applicable requirements in Specification Section 23 21 15, HVAC Drain Piping.
- C. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.
- D. Duct Connections: Duct installation requirements are specified in Specification Section 23 31 13, Metal Ducts. Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Specification Section 23 33 00, Air Duct Accessories.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.

3.4 CLEANING

- A. Filters:
 - 1. Install temporary disposable filters, minimum MERV-8, prior to start-up or operating equipment during construction.

- a. Replace temporary filters when pressure drop across the filter reaches the filter manufacturer's recommended dirty-filter pressure.
2. After completing system installation and start-up, and immediately prior to testing, adjusting and balancing activities, clean filter housings, clean and reinstall washable filters, and replace disposable filters with the filters indicated.
3. After final building cleaning or upon substantial completion, whichever is later, clean filter housings, clean and reinstall washable filters, and replace disposable filters with the filters indicated.

3.5 DEMONSTRATION

- A. Train the Owner's maintenance personnel to adjust, operate, and maintain units.

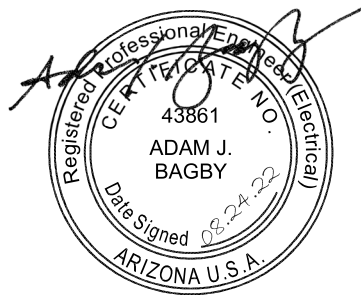
END OF SECTION

Edition 0308-1121

DIVISION 26
ELECTRICAL

26 05 00	Common Work Results for Electrical
26 05 00	General Provisions
26 05 01	Scope of Work
26 05 02	Temporary & Remodeling Work
26 05 19	Low-Voltage Electrical Power Conductors & Cables
26 05 26	Grounding & Bonding of Electrical Equipment
26 05 33	Raceway & Boxes for Electrical Systems
26 05 53	Identification for Electrical Systems
26 09 00	Instrumentation & Control for Electrical Systems
26 09 23	Lighting Control Devices
26 09 25	Lighting Control Devices (Digital Occupancy & Daylight Management System)
26 27 00	Low-Voltage Distribution Equipment
26 27 26	Wiring Devices
26 28 00	Low-Voltage Circuit Protective Devices
26 28 13	Overcurrent Protection
26 28 16	Enclosed Switches & Circuit Breakers
26 51 00	Interior Lighting
26 51 00	Interior Lighting Fixtures & Lamps
26 52 00	Emergency Lighting
26 52 00	Emergency Lighting

END OF INDEX



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SECTION 26 05 00

GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SCOPE

- A. Provisions of this section apply to all work specified in all sections under Division 26.
- B. In addition, work in Division 26 is governed by the provisions of the Bidding Requirements, Contract Forms, General Conditions, and all sections in Division 01 specifications.
- C. The drawings and specifications do not specify exact installation means and methods or Contractor safety procedures. Installation means and methods and safety procedures are, and shall remain, the responsibility of the Contractor. No instruction or statement made on the drawings, specifications, future addenda, or change orders shall be interpreted to shift this responsibility away from the Contractor.
- D. These specifications contain statements which are more definitive or more restrictive than those contained in the General Conditions. Where these statements occur, they shall take precedence over the General Conditions. Where the word "provide" or "provision" is used, it shall be definitely interpreted as "furnishing and installing complete in operating condition." Where the words "as indicated" or "as shown" are used, they shall mean "as shown on the Contract Drawings." Where items are specified in the singular, this division shall provide the quantity as shown on the drawings, plus any spares or extras mentioned on the drawings or in the specifications. All specified and supplied equipment shall be new.

1.2 DEFINITIONS

- A. 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 tunnels, trenches, hollow perimeter construction, above exterior furred spaces, and exterior suspended ceilings.
- B. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings, in duct shafts, and within hollow construction.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations, under canopies, and equipment yards.
- D. Exposed, Interior Installations: Exposed to view indoors. Examples include unfinished spaces, mechanical, electrical, and communication equipment rooms, and other areas solely for maintenance and repair.
- E. Exposed: Not concealed.
- F. Finished Space: A space other than mechanical, electrical, and communication equipment rooms, crawlspaces, and utility tunnels. Not an unfinished space.

- G. Unfinished Space: A room or space that is ordinarily accessible only to building maintenance personnel. A room noted on the "Finish Schedule" with exposed and unpainted construction for walls, floors, or ceilings, or specifically mentioned as "unfinished."

1.3 EXAMINATION OF PREMISES

- A. Visit the site, verify all measurements and project conditions, and pay all costs necessary to perform the work.

1.4 ELECTRICAL CONTRACTOR

- A. The Electrical Contractor shall be licensed as such in the state governing the project location. This license shall remain valid for the duration of the contract and shall have been valid for a minimum of 2 years prior to the contract award date.

1.5 REGULATIONS, PERMITS, FEES, CHARGES, INSPECTIONS

- A. Regulations: Comply with all applicable codes, rules and regulations.
- B. Fees and Permits: Pay all connection, installation, use, development, etc., fees and/or charges. Obtain and pay for all required permits and licenses. Refer to Division 01 specifications.
- C. Inspections: All work must be inspected and approved by local authorities. Prior to final approval, furnish the Architect with certificates of inspections and approvals by the local authorities in accordance with Division 01 specifications.

1.6 DRAWINGS AND SPECIFICATIONS

- A. If a conflict exists on the drawings or between the drawings and specifications, promptly notify the Architect.

1.7 SUBMITTALS

- A. Submittals are for information and coordination only. The Engineer will diligently review the submittals and attempt to verify compliance with the project requirements. Such review, however, does not constitute approval or disapproval or obligation to comply with all project requirements. The submittals are not to be construed to be contract documents. Any failure by the Engineer to note a point of non-compliance shall not be construed to be acceptance or approval of the discrepancy.
- B. Product Information Sheets: Provide manufacturer's literature which includes the information required by the Product Data paragraph of the applicable specification section. Where product information sheets show multiple models or options, clearly mark the model and options to be provided.
- C. Assembly: Assemble all required submittal information for each specification section and submit in PDF format.
 - 1. Assemble PDF submittals in one PDF file for each division. Separate and order sections within each file by corresponding specification number. Provide bookmarks at the first page of each section and label each bookmark with the specification number and name to allow for easy navigation of the submittal.
 - 2. Partial submittals will be returned without review. Partial submittals and submittals that are not project specific will be returned without review.

D. Identification and Information:

1. Name the PDF file with the project name, division number, and sequential submittal number (i.e., the first submittal shall be No. 1; the second submittal shall be No. 2).
2. Provide a cover sheet at the front of each submittal with the following information:
 - a. Project name.
 - b. Date.
 - c. Name of Engineer.
 - d. Name of Contractor.
 - e. Name of subcontractor.
3. Provide a cover sheet at the front of each submittal section with the following information:
 - a. Name of supplier.
 - b. Name of manufacturer.
 - c. Number and title of appropriate specification section.
 - d. Drawing number and detail references, as appropriate.
 - e. Other necessary identification.

E. Options:

1. Identify options requiring selection by the Engineer.
2. Identify options included with submittal item.

F. Deviations: Identify deviations in a line-by-line comparison format to the Contract Documents and include as a cover sheet to the product submittal. Include statement(s) and documentation supporting the acceptability of the deviation.

G. Furnished by Others: This project is to provide a complete and functional system. Where material or labor is indicated in the submittal to be provided "by others," clearly indicated who is providing those items and include information to indicate proper coordination.

1.8 MATERIAL SAFETY DATA SHEETS

- A. Provide current Material Safety Data Sheets (MSDS) for all hazardous chemicals that are proposed for use at the project site.
1. Provide one complete set to the Owner for review and approval a minimum of 1 week prior to the delivery of any hazardous chemicals to the site.
 2. Maintain a second complete set at the project location, readily accessible by both the Owner's personnel and the Contractor's personnel.

1.9 REQUEST FOR INFORMATION

- A. A document submitted by the Contractor requesting clarification of a portion of the Contract Documents, hereinafter referred to as an RFI.
- B. A properly prepared RFI shall include a detailed written statement of the clarification, apparent conflict, or information requested that indicates the specific drawings or specifications in need of clarification and the nature of the clarification requested.
1. Drawings shall be identified by drawing number and location on the drawing sheet.
 2. Specifications shall be identified by section number, page, and paragraph.

- C. Include a proposed solution, where appropriate, based on the field conditions and best knowledge of the Contractor.

1.10 AS-BUILT DRAWINGS

- A. As-Built Drawings: Maintain one set of marked-up paper copies of the Contract Drawings.
 - 1. Preparation: Mark As-Built Drawings to show the actual installation where installation varies from that shown originally. Include all equipment, and underground and overhead conduit.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Include dimensions both horizontally and vertically to permanent points of reference, accurate within 6 inches. Include descriptors such as "below slab," "above ceiling," etc.
 - c. Record data daily or as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - 2. Mark the As-Built Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of the As-Built Drawings.
 - 3. Mark the As-Built Drawings with erasable, red colored pencil, or in a digital PDF format using an editor program such as Bluebeam, Adobe Acrobat Professional, or similar. Use other colors to distinguish between changes for different categories of the work at the same location.
 - 4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
 - 5. Update the As-Built Drawings weekly or daily as appropriate for the project size.
- B. Format: Identify and date each As-Built Drawing; include the designation "PROJECT AS-BUILT DRAWING" in a prominent location.
 - 1. Organize newly-prepared As-Built Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 - 2. Identification, as follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT AS-BUILT DRAWINGS."
 - d. Name of Engineer.
 - e. Name of Contractor.
 - 3. Remove or obscure the Engineer's seal and signature from As-Built drawings.

1.11 OPERATION AND MAINTENANCE MANUAL

- A. Prior to completion of the project, compile a complete equipment Operation & Maintenance Manual for all equipment supplied under Division 26.
- B. Schedule:
 - 1. Submit a preliminary copy of the manual not less than 30 days prior to Substantial Completion for review and comment.
 - 2. Submit the final version of the manual not more than 4 weeks after Substantial Completion of the project.

- C. Format: Submit manuals in the following format:
1. PDF Electronic File: Assemble for each system and piece of equipment, a manual with a composite PDF file, electronically indexed. Provide a system table of contents file with hyperlinks to each of the individual equipment PDF files. Submit on digital media acceptable to the Engineer.
 - a. Name each indexed document file in the composite electronic index with the applicable item name. Include a complete electronically-linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.
 - c. Provide an updated final copy, inclusive of all review comments, to the Engineer and Owner.
- D. Provide Operation & Maintenance Manuals for all systems, subsystems, and equipment that require operation and regular maintenance, or have replaceable parts.
- E. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, product data, manufacturer's 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. In addition to requirements in this section, include operation and maintenance data required in individual specification sections.
- F. Source Information: List each system, subsystem, and piece of equipment included in the manual, identified by product name and arranged to match the manual's table of contents. For each product, list the name, address, and telephone number of the installer or supplier and maintenance service agent, and cross-reference the specification section number and title in the Project Manual.
- G. Product Data: Include the following information:
1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on the Contract Documents.
 2. Approved submittals.
 3. Include the following if not shown on approved submittals:
 - a. Product name and model number. Use designations for products indicated on the Contract Documents.
 - b. Manufacturer's name.
 - c. Equipment identification with serial number of each component.
 - d. Equipment function.
 - e. Operating characteristics.
 - f. Limiting conditions.
 - g. Performance curves.
 - h. Engineering data and tests.
- H. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.

7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures, including precautions against improper use.
 10. Operating logs.
- I. Wiring Diagrams: Diagram of factory-installed wiring including any options as well as any field modifications.
- J. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- K. Manufacturer's Maintenance Documentation: Include 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.
- L. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
 2. Troubleshooting guide.
 3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.
- M. 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.
- N. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturer's maintenance documentation and local sources of maintenance materials and related services.
- O. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- P. Licenses: Include copies of any licenses with requirements, including inspection and renewal dates.
- Q. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
- R. Test Reports: Include a final approved copy of the factory and field testing reports.

1.12 WORK AND MATERIALS

- A. Unless otherwise specified, all materials must be new and of the quality specified. The workmanship shall be of a quality that is acceptable to the Architect, Engineer, and Owner, and is equal to the standards of the trades. The Contractor must staff the project with sufficient skilled workmen, including a fully qualified construction superintendent, to complete the work in the time allotted. The superintendent must be qualified to supervise all of the work in his work category.
- B. Uniformity: Unless otherwise specified, provide all equipment and products of the same type or classification by the same manufacturer.

1.13 APPROVALS OF MATERIALS AND EQUIPMENT

- A. Refer to Division 01 specifications for description of material and equipment for prior approvals and substitutions.

1.14 COOPERATIVE WORK

- A. Correct without charge any work requiring alteration due to lack of proper supervision or failure to make proper provision in time. Correct without charge any damage to adjacent work caused by the alteration. Refer to Division 01 specifications for additional requirements.
- B. Cooperative work includes:
 - 1. General supervision and responsibility for proper location, rough-in, and size of work related to Division 26 but provided under other divisions of these specifications.
 - 2. Installation of sleeves, inserts, and anchor bolts for work under sections in Division 26.
 - 3. Sealing of penetrations through fire and smoke barriers caused by work installed as part of Division 26.

1.15 EXISTING MATERIALS AND EQUIPMENT

- A. Disposition: With the exception of items that are to be re-used or retained by the Owner, all other materials indicated to be removed shall be removed and disposed of by the Contractor. Items that are indicated to be retained or returned to the Owner shall be delivered to a storage area designated by the Owner.
- B. Unused Materials: All unused raceways, conductors, boxes, equipment, and miscellaneous materials shall be removed by the Contractor except where located within walls, below or above existing construction which is not being altered and would require removal and replacement of this existing construction. All visible raceways, conductors, boxes, equipment, and miscellaneous materials shall be removed and sealed or capped within wall, below floor, unless noted otherwise.
- C. Exterior Services: The Contractor shall be responsible for maintaining electrical and control service to the existing building during the construction period. Existing services are to be retained until such a time that the new services, if any, are completely installed and ready for use. Scheduling of service interruptions is to be coordinated with the Architect and Owner.
- D. Disconnect, demolish, and remove electrical systems, equipment, and components that are indicated to be removed.
 - 1. Conduit to be Removed: Remove portion of conduit indicated to be removed and cap or plug remaining conduit with the same or compatible conduit material. Patch insulation, as required, to match adjacent areas.

2. Conduit to be Abandoned In Place: Cap or plug conduit with the same or compatible conduit material.
 3. Equipment to be Removed: Disconnect services and remove equipment.
 4. Equipment to be Removed and Reinstalled: Disconnect and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 5. Equipment to be Removed and Salvaged: Disconnect and remove equipment and deliver to the Owner.
- E. Continuity of Services in Existing Building: The Contractor shall permanently reroute existing electrical and control services or provide temporary connection as required to maintain service to existing receptacles, fixtures, and equipment in the building which are to remain in service.
- F. Rerouting and Relocation of Existing Electrical Equipment and Services in Existing Building:
1. General: The Contractor shall reroute/relocate all existing materials which are in conflict with the building alterations and which are required to be maintained in use.
 2. Existing Raceways and Conductors: Where applicable, existing material may be re-used in its original location unless otherwise indicated.
- G. Testing: All existing services affected by the new construction and which are to remain in operation shall be returned to their original condition. The existing services shall be tested as new, as described in other sections of these specifications. If, for any reason, these requirements cannot be met, the Contractor shall immediately notify the Architect.

1.16 GUARANTEE

- A. Guarantee in writing all material, equipment, installation, and workmanship for all sections under Division 26 to be free from defects of material and workmanship for 1 year from date of final acceptance as outlined in Division 01 specifications. Equipment warranties shall be a minimum of 1 year from date of Substantial Completion or as specified elsewhere. Refer to the specific product specification section for additional warranty terms. Replace without charge any material or equipment proving defective during this period. The guarantee shall include performance of the equipment under all conditions of load, installing any additional items of control and/or protective devices as required.

1.17 ELECTRICAL WIRING

- A. Provide all line voltage power wiring, line voltage interlock wiring, and line voltage control wiring for the equipment that is to be provided under Divisions 21, 22, and 23 unless wiring is specifically shown on the electrical drawings.
- B. The following schedule is intended to summarize the division of work material responsibilities between the Mechanical Contractor, Controls Contractor, and Electrical Contractor.

Item	Furn. By	Set By	Power Wiring	Control Wiring
Equipment Motors	MC	MC	EC	--
Motor Control Center	EC	EC	EC	CC
Motor Starters, Controllers, Contactors, and Overload Heaters	MC*	EC**	EC	CC
Fused and Non-Fused Disconnect Switches	EC	EC	EC	--

Item	Furn. By	Set By	Power Wiring	Control Wiring
Manual Operating Switches, Multi-Speed Switches, Pushbutton Stations, and Pilot Lights	CC	CC	CC	CC
Control Relays and Transformers	CC	CC	CC	CC
Line Voltage Thermostats and Time Switches***	MC	MC	EC	EC
Low-Voltage Thermostats	MC	MC	--	MC
Temperature Control Panels	MC	MC	EC	CC
Smoke Detectors (Duct Mounted)	EC	MC	EC	MC or CC
Motor and Solenoid Valves, Damper Motors, PE and EP Switches	CC	MC	CC	CC
Water Treatment Equipment	MC	MC	EC	CC
MC = Mechanical Contractor CC = Controls Contractor EC = Electrical Contractor *Except where such devices are located in MCCs. **Unless required by these specifications to be provided as part of a factory-furnished assembly (i.e., fan coils, air handlers, chillers, etc.). ***Motor-drive units which are controlled from line voltage automatic controls such as line voltage thermostats, float switches, or time switches which conduct full load current of the motor shall be wired for both power and control under the electrical contract.				

PART 2 - PRODUCTS

2.1 CONCRETE

- A. Where used for structures to be provided under the contract such as bases, pole bases, etc., concrete work and associated reinforcing shall be as specified under that division.
- B. Refer to other sections for additional requirements for underground vaults, duct banks, etc.

2.2 FRAMING CHANNEL

- A. The framing channel shall be a cold-rolled, high-quality, carbon-steel channel with factory-applied, hot-dipped-after-fabrication galvanized finish. Utilize factory-built interconnecting components, mounting straps, connectors, etc., designed for use with the framing channel supplied. Channel nuts shall be spring type and shall utilize standard SAE threads. Provide heavy zinc paint for field touchup. B-Line "B" Series, Unistrut "P" Series, or as accepted by the Architect.

2.3 ROOFTOP SUPPORTS

- A. Where specifically allowed by Part 3, provide pyramid-style composite support base for conduit, cable tray, and equipment. Support base shall be made of a UV-stabilized composite thermoplastic material or UV-resistant rubber and include hot-dip galvanized-steel attachment components. Rubber support base must include a steel load distribution top plate or strut. Support base shall include a low abrasion interface between the base and roof membrane for roof membrane protection. The base thermoplastic or rubber shall be made of 100% recycled material.
- B. Support base shall not have sharp edges and shall be compatible with project roof surfaces including single ply, bituminous, rubberized membrane, metal, and spray foam.
- C. Manufacturer and Product: nVent/Erco Caddy "Pyramid Base" Series, Eaton "Dura-Blok" Series, or as accepted.

2.4 ANCHORS

- A. Anchors shall be expandable-lead type, as manufactured by Ackerman-Johnson, Diamond, Hilti, Pierce, or as accepted by the Architect.
- B. Adjustable concrete hanger inserts shall be as manufactured by Grinnell, or as accepted by the Architect.

PART 3 - EXECUTION

3.1 SUBMITTALS

- A. Prepare submittals as directed for review by the Contractor, Owner, and Architect.
- B. Submit one copy of PDF submittals via email, project website, or other electronic media.

3.2 AS-BUILT DRAWINGS AND RECORD DOCUMENTS

- A. Recording: Post changes and modifications to the As-Built Drawings as they occur; do not wait until the end of the project.
- B. Maintenance of As-Built Drawings and Record Documents: Store Record Documents in the field office, apart from the Contract Documents used for construction. Do not use project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project Record Documents for the Engineer's reference during normal working hours. As-Built Drawings will be reviewed by the Architect, Owner, and Engineer at each pay request review.
- C. Submit As-Built Drawings to the Architect at completion of the project.

3.3 OPERATION & MAINTENANCE MANUALS

- A. Prepare Operation & Maintenance Manuals as directed.
- B. Submit a preliminary electronic copy of the Operation & Maintenance Manual to the Engineer for review.

- C. Upon receipt of comments, make any corrections noted from the Engineer's review and resubmit as required.
- D. Submit the final, corrected Operation & Maintenance Manual in electronic format to the Architect.

3.4 VERIFICATION OF DIMENSIONS

- A. Scaled and figured dimensions are approximate only. Before proceeding with work, carefully check and verify dimensions at the site, and be responsible for properly fitting equipment and materials together and to the structure in spaces provided.

3.5 EQUIPMENT LAYOUT

- A. Drawings are diagrammatic and many offsets, bends, pull boxes, special fittings, and exact locations are not indicated. Carefully study drawings and premises in order to determine best sequence and installation methods, exact locations, feeder and branch circuit routes considering building obstructions and other project limitations.
- B. All equipment furnished with connections in the required locations shall fit the space available and include adequate space for operating and servicing.
- C. Install apparatus and equipment in a manner and in locations to avoid obstructions, preserve headroom, and keep openings and passageways clear.
- D. Do not install conduit runs or cable trays in front of or directly below any portion of the equipment access areas where access would be blocked by the installation.
- E. Do not install conduit runs or cable trays in the path of equipment removal for repairs and or maintenance.

3.6 CUTTING AND PATCHING

- A. Cut work and patch per Division 01 specifications as necessary to properly install the new work. As the work progresses, coordinate necessary openings, holes, chases, etc., in their correct location. If the required openings, holes, and chases are not in their correct locations, make the necessary corrections at no cost to the Owner. Avoid excessive cutting and do not cut structural members without the consent of the Architect. Include as a part of the work all structural framing required by penetrations through the roof and necessary steel to support electrical equipment and raceways between structural steel unless shown on the structural drawings.

3.7 CLOSING-IN OF UNFINISHED WORK

- A. Cover no work until inspected, tested, and approved. Where work is covered before inspection and test, uncover it, and when inspected, tested, and approved, restore all work to original proper condition.

3.8 ACCESSIBILITY

- A. Install all control devices or other specialties requiring reading, adjustment, inspection, repairs, removal, or replacement conveniently and accessibly throughout the finished building. Where any of these devices are shown on the Contract Drawings to be installed above any inaccessible ceiling or behind any inaccessible wall, the Electrical Contractor shall furnish access doors or panels as required.

- B. All access doors or panels in walls and ceilings required for access to control devices, control transformers, relays, power packs, and similar devices are to be furnished and installed as part of the work under this section. Provide type as specified in Division 08 specifications.
- C. Refer to the architectural drawings for type of wall and ceiling in each area and for rated construction.
- D. Coordinate work of various sections to avoid unnecessary duplication of access doors.
- E. Provide doors that pierce a fire separation with the same fire rating as the separation.

3.9 ROOF FLASHINGS

- A. Flash and counterflash all raceways penetrating roofing membrane with flashing per roofing manufacturer's recommendations. Refer to the architectural drawings for detailing of raceway penetrations through roof.

3.10 PRODUCT AND EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. All equipment, detectors, etc., shall be installed in strict conformance with the manufacturer's recommendations and all codes.
- B. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.
- C. Install equipment and raceways level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- D. Install electrical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations.
- E. Install equipment and raceways to allow right-of-way for access to removable panels and service points. This applies to equipment of all disciplines.
- F. Do not install any equipment in an application not recommended by the manufacturer.

3.11 EQUIPMENT ROUGH-IN

- A. Rough-in all equipment and fixtures as designated on the drawings and in the specifications. The drawings indicate only the approximate location of rough-ins. The exact rough-in locations must be determined from stated architectural dimensions, large-scale architectural plans and elevations, and vendor drawings. The Contractor shall obtain all rough-in information before progressing with any work for rough-in final connections.
- B. Be responsible for providing all outlets and services of proper size at the required locations.
- C. Minor changes in the Contract Drawings shall be anticipated and provided for under this division.
 - 1. Rough-in only (unless otherwise designated on the drawings) shall include providing all services as indicated and required, including all raceway, conduit, and conductors. Cap all conduit stubouts in a manner suitable for future extension.

3.12 OWNER-FURNISHED AND OTHER EQUIPMENT

- A. Rough-in only for all Owner-furnished equipment (refer to Division 01 specifications) and all equipment furnished under other sections of the specifications, except as otherwise specified and/or noted on the drawings.
- B. Obtain rough-in drawings from the Owner or other contractors, prior to roughing-in any services.
- C. Provide all services required. Cap all conduit and raceways and leave in a clean and orderly manner.

3.13 EQUIPMENT FINAL CONNECTIONS

- A. Provide all final connections for the following:
 - 1. All equipment furnished under this division.
 - 2. Electrical equipment furnished under other sections of the specifications (except as otherwise designated).
 - 3. Owner-furnished equipment as shown on the drawings.

3.14 WIRING OF EQUIPMENT FURNISHED UNDER OTHER SECTIONS

- A. All electrical wiring including power wiring and control wiring (except as specified in Divisions 21, 22, and 23), including all raceways, wiring, outlet and junction boxes, and labor for installation of the wiring and equipment, shall be included in this section of the specifications.
- B. Wiring diagrams, complete with all connection details, shall be furnished under each respective section.
- C. Provide all connections as described per Divisions 21, 22, and 23.

3.15 EQUIPMENT SUPPORTS

- A. Erection of Metal Supports and Anchorages:
 - 1. Refer to Division 05 specifications for structural steel.
 - 2. Design, cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment. Neatly fabricate and erect steel work with burrs and welding spatter ground off. Paint after fabrication with a rust-inhibitive primer.
 - 3. Field Welding: Comply with AWS D1.1.
- B. Erection of Wood Supports and Anchorages:
 - 1. Design, cut, fit, and place wood grounds, nailers, blocking, and anchorages to support and anchor electrical materials and equipment.
 - 2. 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.
 - 3. Attach to substrates as required to support applied loads.

- C. Where supports, foundations, suspended platforms for transformers, or other equipment are indicated or specified, perform the following:
1. Locate support members to avoid equipment stresses and interference with conduit connections, service panel removal, or other maintenance operations.
 2. Regarding equipment of other disciplines, locate support members to avoid interference with duct, conduit, and piping connections, control connections, service panel removal, or other maintenance operations.
- D. Rooftop supports shall not be used for conduit unless specifically noted on the plans. Where used, coordinate acceptability of support to membrane interface with roof membrane manufacturer and provide accordingly.
- E. Concrete Inserts: Furnish and install all concrete inserts required for all materials and equipment specified and/or shown on the drawings for Division 26.
- F. Concrete Bases: Work under this section includes coordination of construction of all concrete foundations indicated or required for equipment specified under Division 26. Materials and workmanship shall be described in Division 03 specifications. 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 1 inch (25 mm) larger in both directions than supported unit footprint. Where servicing apparatus for drawout circuit breakers requires a level surface in front of the switchboard or switchgear, coordinate pad front extension so as to allow service to occur using standard apparatus. Where utility company connections and equipment occur, pads below underground pull section, meter, and main switch(es) shall conform to the serving utility requirements.
 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
 3. Install epoxy-coated anchor bolts for supported equipment that extends through concrete base, and anchor into structural concrete floor.
 4. Place and secure anchorage devices. Use supported equipment manufacturer's installation drawings, templates, diagrams, and instructions to locate anchors. Install anchor bolts to elevations and embedment depths required for proper attachment to supported equipment.
 5. Install anchor bolts at elevations required for proper attachment to supported equipment.
 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
- G. Grouting:
1. Grout under lighting pole base plate after leveling, filling completely the space between base plate and foundation surface as specified in Division 03 specifications.
 2. Mix and install grout for electrical equipment base bearing surfaces and other equipment base plates, and anchors.
 3. Clean surfaces that will come into contact with grout.
 4. Provide forms as required for placement of grout.
 5. Avoid air entrapment during placement of grout.
 6. Place grout, completely filling equipment bases.
 7. Place grout on concrete bases and provide smooth bearing surface for equipment.
 8. Place grout around anchors.
 9. Cure placed grout.
 10. Finish exposed surface of grout for a neat appearance.

3.16 CLEANUP

- A. In addition to cleanup specified in Division 01 specifications, thoroughly clean all parts of the equipment. Where exposed parts are to be painted, thoroughly clean off any splattered construction materials and remove all oil and grease spots. Wipe the surface carefully and scrape out all cracks and corners.
- B. During the progress of the work, keep the premises clean and free of debris.

3.17 PAINTING

- A. Except as otherwise specified or indicated in the architectural drawings and/or specifications, paint all exposed unfinished metal with one coat of rust-inhibiting primer. Galvanized and factory-painted equipment shall be considered as having primed surface.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- C. Finished painting is specified in Division 09 specifications.

3.18 FIRESTOPPING

- A. Coordinate with the firestopping installer for sealing of all penetrations of fire and smoke barriers and other rated assemblies created during the installation of the Division 26 work.

3.19 OBJECTIONABLE NOISE AND VIBRATION

- A. Construct and brace sheet metal housings to prevent vibration or rattling when systems are in operation. Install connections to equipment so noise and vibration will not reach the conditioned area through conduit, sheet metal work, or the building structure.

3.20 TESTING

- A. Upon completion of the electrical work, the entire installation shall be tested and demonstrated to be operating satisfactorily. Tests and documentation shall be in accordance with NETA Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems.
- B. Tests, calibrations, and settings shall include the following:
 - 1. Wiring shall be tested for continuity, short circuits, and/or accidental grounds. All systems shall be entirely free from grounds, short circuits, and any or all defects.
 - 2. Motors shall be operating in proper rotation and control devices shall be functioning properly. Check all motor controllers to determine that properly sized overload devices are installed. Check all electrical equipment for proper operation.
 - 3. Additional equipment-specific testing is described in the equipment's respective section of this division.
- C. Furnish a written report of testing to the Architect. At a minimum, the report shall include:
 - 1. Testing Contractor's letterhead.
 - 2. Testing technician's name and signature.
 - 3. Date and time that test was performed.
 - 4. Ambient temperature and weather conditions.
 - 5. Test equipment manufacturer, model number, and last calibration date.

6. The manufacturer, model number and, as applicable, trip unit model number and available adjustments of tested equipment.
 7. Statement of "As Left" conditions.
 8. Pass/Fail statement relative to NETA Chapter 10 recommendations.
 9. Recommendations if any.
- D. The Contractor shall submit the testing schedule to the Architect 2 weeks prior to initiation of testing activity.
- E. Ground fault protection (GFP) trip units shall be calibrated and tested prior to energizing any equipment served by GFP devices.
- F. The Contractor shall furnish the necessary instruments and labor required for testing, calibration, and implementation of engineered settings.
- G. Tests and adjustments shall be made prior to acceptance of the electrical installation by the Architect, and a certificate of inspection and acceptance of the electrical installation shall be provided by local inspection authorities.
- H. Any equipment or wiring provided, which through testing proves to be defective or operating improperly, shall be corrected or replaced promptly, at no additional cost to the Owner.

END OF SECTION

Edition: L-2204

SECTION 26 05 01

SCOPE OF WORK

PART 1 - GENERAL

1.1 SUMMARY

- A. The work under this division includes furnishing all labor, material, and equipment necessary for the installation of and placing into operation the electrical systems as indicated on the drawings.
- B. The work shall also include the completion of such minor details of electrical work not mentioned or shown which are necessary for the successful operation of all electrical systems described on the drawings or required by these specifications.

1.2 SCOPE

- A. The work includes, but is not necessarily limited to, furnishing and installing the following:
 - 1. Complete power and lighting systems, safety switches, feeders, branch circuits, lighting fixtures, lamps, controls, and accessories.
 - 2. Motor and power wiring for all motors and/or equipment furnished under the Contract. Except as otherwise specified to be furnished by or under other divisions of these specifications, all wiring devices, starter wiring, conduit, feeders, control wiring, accessories, and final connections to all equipment shall be furnished under this section.
 - 3. Install controls for all equipment except as specified under the automatic temperature control system.
 - 4. All equipment and materials specified in this division.
 - 5. Empty conduit systems as indicated on the drawings.
 - 6. All other items and/or work indicated on the drawings.
 - 7. Equipment lists and maintenance manuals.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

Edition: _L-1801

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SECTION 26 05 02

TEMPORARY & REMODELING WORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Perform all temporary and remodeling work as shown on the drawings and described in the specifications, including minor items of material or equipment necessary to meet the requirements and intent of the project.
- B. All temporary and remodeling work shall be considered a part of this contract and no extra charges will be allowed.
- C. Examine architectural, structural, and mechanical drawings and specifications to determine the sequence of construction throughout the project, including existing, temporary, remodeled, and new areas.
- D. Where drawings indicate existing conditions, an attempt has been made to show electrical equipment, buildings, site details, etc., but accuracy cannot be guaranteed. Verify exact location of all conduits, outlets, etc., and all building and site details.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Branch circuits shall be re-used where practical and shall, in addition, be revised as required. Conceal all work where possible. Where exposed work is required in finished areas, use Wiremold or similar raceway system components as approved by the Architect.
- B. Existing electrical wiring intended to remain in use but which will be disturbed due to construction changes required by this Contract shall be restored to operating condition, as required and/or directed. Where required, shown, and/or directed, outlets and conduit runs shall be relocated. In some cases, it may be necessary to extend conduits and pull in new wiring or install junction boxes and splice in new wiring, or replace old wiring with new.
- C. Outlets from which lighting fixtures, switches, receptacles, and/or other electrical devices are removed and are not intended to be re-used shall be removed or, if it is not possible to remove them, a blank cover shall be placed on the outlet box. Where outlets, boxes, etc., are completely removed, the Contractor shall cut off conduits and remove wiring.
- D. Where conduits extending through floors are to be abandoned, the Contractor shall cut and cap or plug conduit so that it will not protrude above the floor.
- E. Where existing conduit is to be abandoned, the conduit shall be removed if it is exposed, in a crawl space, or in an accessible ceiling. Where it is impossible to remove the conduit, it shall be cut off and capped or plugged.

- F. The Contractor shall be held fully responsible for the proper restoration of all existing surfaces requiring patching, plastering, painting, and/or other repair due to the installation of electrical work under the terms of this specification. Close all openings, repair all surfaces, etc., as required.
 - 1. The Contractor shall employ qualified and experienced workmen for this work. All restoration work shall be subject to the approval of the Architect and/or the Owner.

END OF SECTION

Edition: L-1907

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS & CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install wire and cable for branch circuits and feeders as specified herein and as shown on the drawings.

1.2 RELATED SECTIONS

- A. Specification Section 26 05 53, Identification for Electrical Systems.

1.3 ACTION SUBMITTAL

- A. Submit product data indicating compliance with this specification for each type of conductor and cable.

PART 2 - PRODUCTS

2.1 WIRE AND CABLE

- A. All wire and cable shall be new, 600-volt insulated, of types specified below for different applications. All wire and cable shall bear the UL label and shall be brought to the project in unbroken packages.
- B. Wire and cable 4 AWG size and smaller shall be Type THHN/THWN-2. Wire and cable larger than 4 AWG shall be Type XHHW-2.
- C. Wire and cable supplying Divisions 23, 24, and 25 equipment (and similar) shall be Type XHHW-2 regardless of size.
- D. Wire for branch circuits connected to isolated power systems shall be Type XHHW, no exceptions.
- E. Conductor Material:
 - 1. Annealed copper for all sizes. Encore Wire, General Cable, Southwire, or as accepted.
- F. Conductor Stranding:
 - 1. Wire size 14 AWG and larger shall be stranded.
- G. Wire Pulling Lubricant:
 - 1. American Colloid "Slip X-300."
 - 2. American Polywater A, C, G, & J.
 - 3. Electro "Y-er Eas."
 - 4. Ideal "Wire Lube."
 - 5. Mac "Wirepull."

6. Minerallac "Wire-Wax."
7. Quelcor "Quelube."
8. Richards "Gel Lube 7/5."
9. Thomas/Jet Line "Slipry Loob."

- H. Metal-clad (MC) cable shall be steel corrugated interlocking type and shall include an equipment ground conductor. Where used in medical applications, MC cable shall be hospital grade, steel corrugated interlocking type, and shall include an equipment ground conductor listed for use in NEC 517.13 systems. AFC, AmerCable, or as accepted. MC cable shall not be permitted to be used on this project unless indicated on the drawings or as noted in PART 3 of this section.
- I. Armor-clad (AC) cable shall not be permitted to be used on this project.
- J. Fire-rated cable assemblies shall be Draka Cableteq "Lifeline RHW" 600-volt copper, or as accepted.

2.2 TERMINATIONS, SPLICES, AND JOINTS

A. Terminations:

1. Locking fork, 600-volt vinyl insulated, butted seam, 3M Scotchlok terminals or as accepted.
2. Ring tongue, 600-volt vinyl insulated, butted seam, 3M Scotchlok terminals or as accepted.
3. Round flange solderless lug. Burndy "Quick-Lug" Type QDA, or as accepted.
4. Solderless lug with water-resistant self-sealing gel cover. RayChem GelCap or as accepted.
5. Solderless compression lug type, one- or two-hole. Blackburn, Burndy, IlSCO, or as accepted.
6. Mechanical lug type listed for the application. Lug shall include an insulating cover. Burndy, IlSCO, or as accepted.
7. Flexible ferrule, copper, 600-volt, non-insulated. Dottie, NSi Industries, or as accepted.
8. Termination of stranded wire 10 AWG or smaller on breakers and wiring devices shall include a captive plate design.

B. Splices and Joints:

1. Pressure-type solderless insulated square spring connectors. 3M Scotchlok, Buchanan BCAP, Ideal Wing-Nut, Ideal Wire-Nut, or as accepted.
2. Solderless mechanical in-line lug with formed insulating cover, 600-volt minimum rating. Material shall be listed for use with the specific conductor material. Blackburn, Burndy, IlSCO, NSi, Panduit, or as accepted.
3. Solderless compression type, long barrel with dimpled center stop and heat- or cold-shrink 600-volt insulation. Splice material shall match conductor material. Blackburn, Burndy, IlSCO, or as accepted.
4. Exterior Below Grade Joints in Wire (specific, case-by-case approval by the Engineer is required):
 - a. Pressure-type solderless insulated square spring connectors with self-sealing gel, UL 486D listed. Ideal Underground or as accepted.
 - b. Solderless lug, solderless compression lug with watertight self-sealing gel cover. Raychem GelCap or as accepted.
5. Insulative Tape: Self-fusing, ethylene propylene rubber backing and highly conformable, rubber-resin adhesive. Temperature rated for continuous adhesion to 194°F (90°C). 30-mil thickness, voltage rated to 69kV. 3M Scotch 23 or as accepted.

- C. Wire Taps: Solderless mechanical or compression lug, irreversible compression "H" tap, each with formed insulating cover or heat/cold-shrink insulation, 600-volt minimum rating. Tap material shall be listed for use with the specific conductor material. Blackburn, Burndy, Ilco, Raychem Gtap, or as accepted.

2.3 APPLIED INSULATION

- A. Insulating materials shall be listed for the application. Voltage rating shall be equal to or greater than the factory-applied wire insulation. 3M, Ilco, Raychem, or as accepted.

PART 3 - EXECUTION

3.1 GENERAL WIRING

- A. Drawings, in general, indicate location of items of equipment. Exact locations of motors and other devices are to be determined in the field by the Contractor. Provide an electrical feed for all equipment, not smaller than shown or NEC size where size is omitted from the drawings, together with a suitable circuit protective device. Verify panel schedules and layout, maintaining number of spare branches indicated.
- B. Complete rough-in requirements of all equipment to be wired under the Contract are not indicated. Coordinate with respective trades furnishing equipment or with the Architect, as the case may be, for complete and accurate requirements to result in a neat, workmanlike installation.
- C. Feeder conductors to distribution equipment shall be adjusted to limit voltage drop. The Contractor shall review the anticipated installed length and confirm the selected feeder results in not more than 2% voltage reduction. Base calculations on the actual load, or where the actual load is not known, 80% of the load side equipment bus rating.
- D. Conductors for branch circuit lighting, receptacle, power, and miscellaneous systems shall be as stated in this section. Wire indicated specifically to be larger than the specified minimum shall be increased for the entire length of the circuit.
- E. Conductor sizes for lighting, receptacles, and small motor branch circuits with less than a 20-amp connected load are not shown. Conductors for such circuits are sized as follows for a 3% voltage drop to single load. Submit alternate lengths with supporting calculations for review prior to installation.

BRANCH CIRCUITS		
Voltage	Length (from Branch Circuit Panel to Load)	Conductor Size (Not Smaller Than)
120 Volt	66 Feet	No. 12 (16 Amps)
120 Volt	102 Feet	No. 10 (16 Amps)
120 Volt	163 Feet	No. 8 (16 Amps)
120 Volt	256 Feet	No. 6 (16 Amps)
208 Volt	114 Feet	No. 12 (16 Amps)
208 Volt	177 Feet	No. 10 (16 Amps)
208 Volt	283 Feet	No. 8 (16 Amps)
208 Volt	443 Feet	No. 6 (16 Amps)
277 Volt	153 Feet	No. 12 (16 Amps)
277 Volt	236 Feet	No. 10 (16 Amps)
277 Volt	376 Feet	No. 8 (16 Amps)

BRANCH CIRCUITS		
Voltage	Length (from Branch Circuit Panel to Load)	Conductor Size (Not Smaller Than)
277 Volt	590 Feet	No. 6 (16 Amps)

3.2 INSTALLATION

- A. Wire and cable shall be pulled into conduits without strain, using an approved lubricant.
- B. In no case shall wire be re-pulled if same has been pulled out of a conduit run for any purpose.
- C. No conductors shall be pulled into conduit until conduit system is complete, including junction boxes, pull boxes, etc.
- D. Feeder conductors shall be installed without splicing except where run length is in excess of 500 feet.
- E. All connections to wiring devices, circuit breakers, switches, fixtures, motors, and all joints in wires shall be made as noted below:
 1. Terminations at Wiring Devices:
 - a. 12 AWG Solid Wire: Formed around binding post or screw.
 - b. 14 through 10 AWG Stranded Wire: Locking fork tongue where terminals do not have a captive plate.
 - c. 8 AWG and Larger: Terminate via splice to device modular connector pigtails.
 2. Terminations at Circuit Breakers and Switches:
 - a. 14 through 10 AWG Stranded Wire: Locking fork tongue where terminals do not have a captive plate.
 - b. 8 AWG and Larger Wire: Where device does not include a captive plate or factory-provided lug, utilize a ring tongue.
 - c. 6 AWG and Larger Wire: Round flange solderless lug, Burndy "Quick-Lug" Type QDA or as accepted.
 3. Motor Connections: Use the factory-supplied terminal. Where motor is provided without terminals and leads only, provide solderless lug with water-resistant self-sealing gel cover.
 4. Joints in Wire:
 - a. 8 AWG and Smaller Wire: Pressure-type solderless square spring connectors.
 - b. 6 AWG and Larger Wire: Irreversible compression type, long barrel.
 - c. Wire Taps: Solderless compression lug, irreversible compression "H" tap. Material shall be listed for use with the specific conductor material.
 - d. Exterior Below Grade Joints in Wire (specific, case-by-case approval by the Engineer is required): Solderless lug, solderless compression lug.
 - 1) 6 AWG and Smaller Wire: Pressure-type solderless square spring connectors with self-sealing gel.
 - 2) Larger Than 6 AWG Wire: Solderless lug, solderless compression lug with watertight self-sealing gel cover.
 5. Other Equipment: Use mechanical lug furnished with the equipment or listed for the application.

6. Solderless connectors NOT used for grounding shall be insulated. Apply wire insulation with voltage rating equal to or greater than the factory-applied wire insulation. Insulate by the following methods:
 - a. Pre-manufactured insulating caps.
 - b. Heat- or cold-shrink insulating sleeve. Shrink in accordance with the manufacturer's recommendations.
 - c. With Engineer Approval Only: One or more layers of ethylene propylene rubber tape, equal in thickness to the conductor insulation installed per the manufacturer's written instructions.
7. Wire compression-type sleeves or lugs shall be installed with the manufacturer's recommended tool, in accordance with their published instructions.
8. Termination of finely stranded conductor, such as Type W, shall be made using a flexible ferrule.
9. Each conductor termination shall be tightened to the torque value recommended by the termination manufacturer. Terminations shall be marked once the final torque has been applied. Torque wrenches used for this purpose shall be calibrated and certified per NETA recommendations.
10. Grounding electrode conductor splices and terminations shall be irreversible type.

3.3 COLOR CODING AND MARKING

- A. All wiring throughout shall be color-coded as follows:

	480-Volt System	208-Volt System
A Phase	Brown	Black
B Phase	Orange	Red
C Phase	Yellow	Blue
Neutral*	Grey	White
Ground	Green	Green
Iso Ground		Green with Yellow Stripe

*Where multiple neutrals are installed within the same raceway, each individual neutral shall be distinctly identified by one or more color stripes.

Where a project includes multiple distribution voltages, each piece of distribution equipment shall be permanently marked with the color code in use. This label shall not be handwritten and must be of sufficient durability for the environment.

- B. All control wiring in a circuit shall be color-coded, each phase leg having a separate color, and with all segments of the control circuit, whether in apparatus or conduit, utilizing the same color-coding.
- C. Wiring must be color-coded throughout its entire length, except that feeders may have color-coded plastic tape at both ends and all accessible points.
- D. At all terminations of control wiring, the wiring shall have a numbered wire marker.
- E. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.4 CLAD CABLE ASSEMBLIES

- A. Metal clad (MC) cables may be used for branch circuits as follows:
 - 1. For branch circuits within architectural millwork.
 - 2. Building branch circuits serving common spaces, corridors, public toilets, elevator lobbies, game rooms, and similar.
 - 3. Mechanical controls power routed above accessible ceilings.
- B. Metal clad (MC) cables shall be permitted to be installed on a limited basis, per the following parameters:
 - 1. For branch circuits within architectural millwork.
 - 2. For branch circuits within a single room, originating from a junction box in the above-ceiling space of the room. Branch circuiting supply to the above-ceiling junction box shall be in conduit.
 - 3. As branch circuit "through-wiring" to lighting fixtures installed in gypsum board soffit or other inaccessible areas.
 - 4. For mechanical controls power routed above accessible ceilings.
- C. Metal clad (MC) cables shall NOT be used as follows:
 - 1. Where disallowed by NEC 517.31(C)(3).
 - 2. Areas below grade and garage level.
 - 3. To supply mechanical equipment, water heaters not serving a residence, HVAC units, exhaust fans greater than 150 cfm, pumps, etc.
 - 4. Kitchens, laundries, other back-of-house areas below grade.
 - 5. Areas subject to chlorine gas exposure, pool/spa rooms, and related equipment rooms.
- D. Metal clad (MC) cable shall be installed with:
 - 1. Anti-shorting devices at each termination.
 - 2. Termination fittings designed and listed for the application.

3.5 FIRE-RATED CABLE ASSEMBLIES

- A. Fire-rated cable assemblies shall be permitted where fire-rated cable assemblies are specifically allowed by the NEC. Coordinate use with project Fire/Life Safety Analysis Documents. Provide a copy of listing requirements to the local Authority Having Jurisdiction (AHJ) for inspection during construction. Install according to the listing requirements.

3.6 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 Specification Section 26 05 43, Underground Ducts & Raceways for Electrical Systems.

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Specification Section 07 84 13, Penetration Firestopping.

END OF SECTION

Edition: L-2204

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SECTION 26 05 26

GROUNDING & BONDING OF ELECTRICAL EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install grounding and grounding conductors as specified herein and as shown on the drawings.

1.2 ACTION SUBMITTAL

- A. Submit product data indicating compliance with this specification for each type of ground system component.
- B. Submit ground system test reports to the Architect for review.

1.3 CLOSEOUT SUBMITTAL

- A. Include final ground system test reports in the project Operation & Maintenance Manual.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Stranded copper with 600-volt green insulation.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B3.
 - 2. Stranded Conductors: ASTM B8.
 - 3. Tinned Conductors: ASTM B33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of #17 AWG conductor, 1/4 inch (6 mm) in diameter.
 - 5. Bonding Conductor: #4 or #6 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
- C. Ground Busbar: Predrilled rectangular bars of annealed copper, size as noted on the plans, but not less than 1/4-inch thick by 4 inches tall by 24 inches wide. Hole pattern shall be 9/32-inch holes spaced 1-1/8 inches on center or as noted on the plans. Standoff insulators for mounting shall comply with UL 891 for use in switchboards, 600 volts, and shall be Lexan or PVC, impulse tested at 5,000 volts. Standoff insulators shall be minimum 2 inches and mounted using minimum 2-inch steel supports. Assemblies manufactured by Burndy, IlSCO, Blackburn, or as accepted.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory (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. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Ground Busbar Connectors: Tin-plated copper, two-hole, long-barrel solderless compression.
- D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual tin-plated or silicon bronze bolts.
- E. Cable End-to-End Splices: Tin-plated copper, long barrel, end-to-end compression connectors with inspection window. Provide with listed shrink on insulation.
- F. Cable Tap Splices: Tin-plated copper, heavy-duty C-tap compression connectors for splices where all conductors are #2 AWG or smaller. Tin-plated copper H-tap compression connectors with insulative cover for all other splices.
- G. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.
- H. Conduit Hubs: Mechanical type, terminal with threaded hub.
- I. Ground Rod Clamps: Mechanical type, copper or copper alloy terminal with hex head bolt, listed for direct burial. Manufactured by Burndy, IlSCO, Blackburn, or as accepted.
- J. Flexible Ground Straps: Copper, flat-braided type with formed single-hole end pads.
- K. Rod and Pipe Clamps: Silicone bronze ground clamp up to 4-inch nominal pipe diameter. Field-welded bonding tabs for two-hole connectors for larger sizes.

2.3 GROUNDING ELECTRODES

- A. Ground rods shall be copper or copper-clad steel, 3/4-inch diameter by 10 feet long, listed for the purpose.
- B. Plate electrodes shall be sized as noted on the plans, but not less than 2 feet round by 1/4-inch (6.35 mm) thick steel or iron. Where copper or bronze plates are used, thickness shall not be less than 1/16 inch (1.5875 mm).
- C. Concrete-encased electrodes shall consist of bare copper conductor, in direct contact with the concrete foundation, sized as noted on the plans, but not less than #4 AWG solid copper.
- D. Ground ring shall consist of bare tinned copper stranded conductor, sized as noted on the plans, but not less than #2 AWG. Minimum length shall be 20 feet.
- E. Common Electrode System (CES) for multiple separately derived systems. The CES shall consist of a copper stranded conductor sized as noted on the plans, minimum #3/0 AWG.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. All panelboard cabinets, equipment, enclosures, and conduit systems shall be grounded securely in accordance with pertinent sections of the NEC, as amended by any local codes. Conductors shall be copper. All electrically operated equipment shall be bonded to the grounded conduit system. All non-current-carrying conductive surfaces that are likely to become energized and subject to personal contact shall be grounded by one or more of the methods detailed in the NEC. All ground connections shall have clean contact surfaces. Install all grounding conductors in conduit and make connections readily accessible for inspection.
- B. Grounding of metal raceways shall be assured by means of grounding bushings on feeder conduit terminations at the service entrance, distribution switchboards, and panelboards, and by means of a continuous, stranded, copper grounding wire extended from the ground bus in the enclosure to the conduit grounding bushings.
- C. A separate insulated grounding conductor, sized per the NEC, shall be installed in all electrical metallic tubing (EMT).
- D. Ground cable basket/tray with #6CU AWG conductor between grounding electrode system and cable tray. Utilize listed grounding connectors. Route in conduit between grounding electrode system and first connection to cable basket/tray.
- E. Rod, Pipe, and Plate Electrodes: Install per National Electrical Code (NEC) Article 250.53. Ground rods shall be installed full length, uncut. Top of ground rods shall be driven to a minimum of 2 inches below finished floor or grade.
- F. Concrete-Encased Electrodes: Install within the building foundation as described in NEC Article 250.52(A)(3).
- G. Ground Rings: Install per NEC Article 250.52(A)(4) at a minimum of 5 feet from the building and a minimum of 30 inches below finished grade or 6 inches below the frost line where deeper.
- H. Exterior direct-buried ground conductors shall be bare tinned copper at a minimum depth of 30 inches below finished grade or 6 inches below the frost line where deeper.
- I. Equipment grounding conductor size shall be increased where feeder conductors are oversized for voltage drop in accordance with NEC 250.122(B).
- J. Ground Busbars: Mount with a minimum of two standoff insulators.
- K. Labeling: Label all ground bar connections as to the element grounded or bonded with non-metallic tags and attachments.
- L. Ground conductors shall be exposed within electrical and MER/TR equipment rooms and installed in conduit elsewhere.
- M. Where grounding and bonding conductors are installed in metallic conduit, each end of the raceway shall be bonded to the grounding conductors by means of listed bond bushings. Where bushings are not available for the conduit and cable size, listed pipe clamps may be used in lieu of bushings.
- N. Use exothermic welds for all below grade connections except at test wells where mechanical connections shall be used.

- O. All interior connections shall be mechanical or compression type.
- P. All grounding conductors shall maintain a downward or horizontal direction where possible. Minimum bending radius of ground conductors shall be 8 inches.
- Q. Do not encircle ground cables completely with magnetic metal (i.e., conduit straps, junction boxes, etc.). Use one-hole straps with nylon screws, fiberglass channel framing, or similar. Where encirclement cannot be avoided, provide a #6 AWG bond to the metal encirclement.
- R. Connections of Dissimilar Metals: Coat surfaces with "NO-OX-ID-A" compound.
- S. Air Plenums or Other Spaces used for Environmental Air: Insulated ground cables shall not be exposed within. Where routing or connections are required in such spaces, provide bare copper conductors.

3.2 SPLICES

- A. Where a splice is required, it shall be made with a UL Listed, irreversible compression-type connector or exothermic welding.
- B. Exothermic welds shall be cast with size-appropriate molds as recommended by the thermal weld manufacturer.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections of the installed grounding systems.
- B. Tests and Inspections:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 - 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 - 4. Prepare dimensioned drawings locating each test well, ground rod, and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location.
 - 5. Report shall include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- C. Grounding system will be considered defective if it does not pass tests and inspections.

- D. Prepare test and inspection reports. Reports shall include:
1. Name of equipment tested or locations in the system tested.
 2. Test type and purpose.
 3. Resultant test value(s).
 4. Statement of pass or fail.
 5. Test technician name, signature, and date for each report.
- E. Report measured ground resistances.
- F. Excessive Ground Resistance: If resistance to ground exceeds IEEE Standard 142 recommendations, notify the Architect/Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION

Edition: L-2101

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SECTION 26 05 33

RACEWAY & BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install conduit and fittings as shown on the drawings and as specified herein.

1.2 COORDINATION

- A. It shall be the responsibility of the Contractor to consult the other trades before installing conduit and boxes. Any conflict between the location of conduit and boxes, piping, ductwork, or structural steel supports shall be adjusted before installation. In general, large pipe mains, waste, drain, and steam lines that pitch, large air ducts, and all structural steel shall be given priority.
- B. Conduit size shall be such that the required number and sizes of wires can be easily pulled in and the Contractor shall be responsible for the selection of the conduit sizes. Conduit sizes shown on the drawings are minimum sizes in accordance with appropriate tables in the National Electrical Code (NEC). If, because of bends or elbows, a larger conduit size is required, the Contractor shall so furnish without further cost to the Owner.
- C. The Contractor shall be entirely responsible for the proper protection of this work from the other trades on the project. When conduit becomes bent, holes are punched through same, or outlets are moved after being roughed-in, the Contractor shall replace same, without additional cost to the Owner.

1.3 RELATED SECTIONS

- A. Specification Section 26 05 53, Identification for Electrical Systems.
- B. Specification Section 26 27 26, Wiring Devices.

1.4 ACTION SUBMITTAL

- A. Submit product data indicating compliance with this specification for each type of box, conduit, raceway, fitting, wall and trench duct.
- B. Exposed Conduit Routing: Where conduit must be exposed in finished areas, submit a routing diagram to the Architect for acceptance prior to installation. Submittal shall include sufficient detail to communicate the route vertically and horizontally with heights stated.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Conduit sizes for various numbers and sizes of wire shall be as required by NEC Chapter 9, but shall not be smaller than 3/4-inch size except as otherwise noted.
- B. Each length of conduit shall be stamped with the name or trademark of the manufacturer and shall bear the UL label for the specific product type.

- C. All concrete inserts and pipe clamps shall be galvanized. All steel bolts, nuts, washers, and screws shall be galvanized or cadmium plated. Individual hangers, trapeze hangers, and rods shall be prime-coated.
- D. Calibrated pull string/measuring tape shall be Greenlee Part No. 435, or as accepted.

2.2 CONDUIT

- A. Rigid galvanized steel (RGS), intermediate metallic conduit (IMC), and electrical metallic tubing (EMT):
 - 1. Each type shall be UL listed to the current standard.
 - 2. Acceptable Manufacturers: Allied Tube & Conduit, Republic Conduit, Western Tube & Conduit Corp., Wheatland Tube Company, or as accepted.
- B. PVC-Coated RGS or IMC:
 - 1. Minimum Exterior PVC Coating: 40 mils bonded to the exterior surface.
 - 2. Minimum Interior Urethane Coating: 2 mils on both interior and steel threads.
 - 3. Listed as UL 6 and compliant with ANSI C80.1 and NEMA RN 1.
 - 4. Acceptable Manufacturers: Robroy Industries Plasti-Bond/KorKap/ Perma-Cote, Thomas and Betts Ocal, or as accepted.
- C. Polyvinyl chloride (PVC) conduit shall be Cantex, Carlon, or as accepted.
- D. Flexible metallic conduit (FMC):
 - 1. Galvanized steel.
 - 2. Listed as UL 1, UL 1479.
 - 3. Wall thickness as noted in Part 3.
 - 4. Acceptable manufacturers are: Atkore AFC Cable Systems, Southwire, Electri-Flex, Anaconda, or as accepted
- E. Liquid-tight flexible metallic conduit (LFMC):
 - 1. Listed as UL 360 and CSA C22.2 No. 56 requirements. The finished Type LFMC dimensions shall be in accordance with Table 5.1 of UL 360 and Table 2 of CSA C22.2 No. 56,
 - 2. Galvanized steel with a sunlight resistant, flame retardant PVC jacket.
 - 3. Product shall be available in a variety of sub configurations for specific environmental applications:
 - a. Low Smoke Zero Halogen Cable – Type LSZH.
 - b. Hi-Low Temperature.
 - c. Splash Zone in Food Production Areas - PVC jacket (white) does not promote the growth of bacteria, marked NSF 169 compliant.
 - d. Computer Blue with extended UL performance testing.
 - 4. Acceptable manufacturers are: Atkore AFC Cable Systems, Southwire, Electri-Flex, Anaconda Sealtite, or as accepted.

F. Liquid-tight flexible non-metallic conduit (LFNC):

1. Listed as UL 1660 and CSA C22.2 No. 227.2.1. The wall thicknesses and dimensions of the layered conduit shall comply with Table 1 of harmonized UL 1660/CSA C22.2 No. 227.2.1 of UL 1660.
2. Layered Type A construction, nylon reinforced braid between two layers. PVC shall be a Flame retardant, Sunlight resistant, Oil resistant, and Mild acid resistant compound.
3. Product shall be available in a variety of sub-configurations for specific environmental applications:
 - a. Splash Zone in Food Production Areas - PVC jacket (white) does not promote the growth of bacteria, marked NSF 169 compliant.
 - b. Orange PVC jacket.
4. Acceptable manufacturers are: Atkore AFC Cable Systems, Electri-Flex, or as accepted

G. Conduit systems shall be color coded. Reference Specification Section 26 05 53, Identification for Electrical Systems, for additional requirements.

2.3 FITTINGS

- A. Couplings and connectors for RGS or IMC conduit shall be steel or malleable iron, threaded, and rain- and concrete-tight. Couplings and connectors that are exposed, installed in hollow construction, or above ceilings shall be threaded, uncoupled, or compression type. Steel compression-type fittings shall be used for interior EMT and metallic flex. Steel weathertight compression fittings shall be used for exterior EMT. Die-cast or pressure-cast EMT and metallic flex fittings shall NOT be allowed.
- B. Liquid-tight metallic flex connectors shall be steel or malleable iron.
- C. Bushings and locknuts shall be malleable iron with sharp, clean-cut threads.
- D. Fittings shall be Appleton, Crouse-Hinds, Steel City, T&B, or as accepted.
- E. Expansion joint fittings on RGS or IMC conduit shall be Crouse-Hinds Type XJ, or as accepted. Expansion joint fittings on PVC conduit shall be Carlon Type E945, or as accepted.
- F. Entrance seals shall be O.Z. Type FSK, or as accepted.
- G. Explosion-proof and temperature seals shall be listed for 40% fill application, vertical and horizontal, and shall be Appleton Type EY, or as accepted.
- H. Couplings and connectors for PVC conduit shall be of the same manufacturer as the conduit to be coupled or connected. Fittings shall be provided in accordance with the manufacturer's recommendations.

2.4 SURFACE RACEWAY

- A. Where devices are shown within the surface raceway, they shall meet the requirements of a "Multi Outlet Assembly" as described in Specification Section 26 27 26, Wiring Devices.

2.5 BOXES

- A. All boxes must conform to the provisions of NEC Article 314. All boxes shall be of the proper size to accommodate the quantity of conductors enclosed in the box. Boxes shall not be less than 4 inches square and 1-1/2 inches deep unless otherwise noted.
- B. Generally, boxes shall be hot-dipped galvanized steel with knockouts. Where recessed, boxes shall have square cut corners. Outlet, switch, and gang size junction boxes on exterior surfaces or in damp locations shall be corrosion-resistant, cast malleable iron. Boxes shall have threaded hubs for rigid conduit and neoprene gaskets for their covers. Boxes shall be Appleton Type FS or FD, Crouse-Hinds, or as accepted. Conduit bodies shall be corrosion-resistant, cast malleable iron, and shall have threaded hubs for rigid conduit and neoprene gaskets for their covers. Bodies shall be Appleton Unilets, Crouse-Hinds, or as accepted.
- C. Deep boxes shall be used in walls covered by wainscot acoustical wall panels or paneling and in walls of glazed tile, brick, or other masonry that will not be covered with plaster. The bottom of the box shall be located on the horizontal joint. Through-the-wall type boxes shall not be used unless specifically called for. All boxes shall be non-gangable. Boxes in concrete shall be of a type to allow the placing of conduit without displacing the reinforcing bars. All lighting fixture outlet boxes shall be equipped with the proper fittings to support and attach a light fixture.
- D. All light switches, receptacles, and similar outlets shall be provided with approved boxes, suitable for their function. Back boxes shall be furnished and installed as required for the equipment and/or systems under this Contract.
- E. Pull and junction boxes shall be substantially-made code-gauge boxes with screw covers. Boxes shall be rigid under torsional and deflecting forces and shall be provided with angle-iron framing where required. Boxes shall be 4 inches square with a blank cover in unfinished areas and with a plaster ring and blank cover in finished areas, and shall be installed where required to pull cable or wire, but only in finished areas by approval of the Architect. Boxes shall be rigidly attached to the structure, independent of any conduit support. Boxes shall have their covers accessible. Covers shall be fastened to boxes with machine screws to ensure continuous contact all around. Covers for surface-mounted boxes shall line up evenly with the edges of boxes. Covers for flush-mounted oversize boxes shall extend 3/4 inch past the box all around. Covers for 4-inch square and 4-inch ganged boxes shall extend 1/4 inch past the box all around.
- F. Outlets are only approximately located on the plans and great care must be used in the actual location of outlets by consulting the various detailed drawings. Outlets shall be flush with finished wall or ceiling. Trim, cases, or other fixtures shall have their boxes installed symmetrically on such trim or fixture. Refer to the drawings for location and orientation of all outlet boxes.
- G. Furnish and install all plaster rings as may be required. Plaster rings shall be installed on all boxes where the boxes are recessed. Plaster rings shall be of a depth to reach the finished surface. Extension rings, where required, shall be installed so that the plaster ring is flush with the finished surface.
- H. Exterior gang-type boxes shall be cast type. Where any box occurs within 12 inches of the earth, provide cast iron type.
- I. Boxes with unused punched-out openings shall have the openings filled with factory-made knockout seals.

- J. Construct pull boxes and rack space for future conduits equal to 25% of present runs. Provide required barriers. Attach a plastic label to each pull box cover listing the feeder numbers enclosed within and the source of current. Identify each conduit at pull box termination with voltage and feeder number in red. Provide sufficient cable slack at terminations and in junction and pull boxes to allow for cable contraction and for future splicing. Fireproof cable in pull boxes where more than one feeder is enclosed.
- K. Boxes shall be as manufactured by Appleton, Racco, Steel City, or as accepted.

2.6 TV / MONITOR BOXES

- A. Boxes must conform to the provisions of NEC Article 314. All boxes shall be of the proper size to accommodate the quantity of conductors enclosed in the box. Boxes shall be available in multi-gang configurations but not less than a 4" high x 2-1/2" wide x 2-1/2" deep power wiring compartment unless otherwise noted.
- B. TV/Monitor boxes shall be recessed type with square cut corners. Boxes shall be corrosion-resistant hot-dipped galvanized steel with knockouts. Power and data side shall be separated by field-configurable voltage divider. Box shall include flanged regressed trim ring to permit the connection of plugs and cables to the devices contained within while remaining inside the wall surface plane. Boxes shall be Arlington Industries, Inc., FSR Inc., or as accepted.

2.7 FLOOR BOXES

- A. All boxes must conform to the provisions of NEC Article 314. Box construction shall be UL 514A Listed.
- B. The floor box unit shall be stamped steel for above grade applications and cast iron where installed in a slab-on-grade condition. The box assembly shall provide for a 1-3/4-inch pre-pour and a 1/2-inch after-pour adjustment. The box shall be concrete-tight and treated to prevent corrosion. The box shall be of the proper size to accommodate the quantity of conductors enclosed in the box. Each compartment shall accept 1-inch conduits. Provide barriers between systems operating at different voltages.
- C. Floor box internal activation shall include mounting plates and brackets for devices indicated as required for the intended use.
- D. Floor box activation shall be made of cast brass and consist of a carpet or hard surface flange and cover plate with openings as required for the intended use.
- E. Basis of design for single or multi-gang single voltage service RECTANGULAR box and activation is Wiremold/Walker Model 880 OmniBox Series deep. Activation shall be rectangular style singular flip lid, except equipment feeds shall be threaded communications cover. Trim style shall accommodate the surrounding surface, flush with tile, flanged with carpet, etc. Subject to project requirements and specifications, acceptable similar products are as follows:
 - 1. FSR Inc. FL-200 Series.
 - 2. Hubbell B2400 Series.

- F. Basis of design for single service box and ROUND activation is Wiremold/Walker Model 880 Series deep single-service. Activation shall be 885GFI Series single lid, except equipment feeds shall be 896 Series. Trim style shall accommodate the surrounding surface, flush with tile, flanged with carpet, etc. Subject to project requirements and specifications, acceptable similar products are as follows:

1. Hubbell B2500 Series.

2.8 RECESSED MULTI-SERVICE FLOOR BOXES

- A. Meet the same requirements as floor boxes except as follows:

1. Telephone/data compartments shall accept up to 1-1/4-inch conduits.
2. Activation covers shall be cast metal material, brass as specified.
3. Basis of design for box and activation is Wiremold/Walker Model RFB Series. Provide “-OG” suffix where installed in a slab-on-grade condition. Activation shall be FPB Series except furniture feeds shall be FPFF Series. Trim style shall accommodate the surrounding surface, flush with tile, flanged with carpet, etc. Subject to project requirements and specifications, acceptable similar products are as follows:
 - a. FSR Inc. FL-200 or FL-500P Series.
 - b. Hubbell CFB Series.

PART 3 - EXECUTION

3.1 CONDUIT

- A. Applications:

1. PVC conduit may be used for all exterior underground systems, in slab, below slab-on-grade, and in concrete or masonry walls. For medical applications, PVC conduit shall not be used to supply power to medical equipment or branch circuits in patient care areas, NO EXCEPTIONS.
 - a. All plastic conduit shall be rigid, Schedule 40, heavy wall PVC.
 - b. Install bell ends at all conduit terminations in manholes and pull boxes and under equipment.
 - c. All bends over 30 degrees shall be made with wrapped IMC.
 - d. Stubups below switchboard/switchgear equipment shall be between 1 and 2 inches above the floor surface with the bell fitting installed.
 - e. All plastic conduit, except that used for telephone, shall contain a code-sized bond wire.
2. IMC shall be used for all conduit larger than 2 inches, and for all underground or in-slab conduit, except where PVC is permitted or where RGS is specified. IMC conduit shall be used in explosion-proof areas.
3. RGS conduit shall be used in place of IMC or where it is specified on the plans.
4. PVC-coated RGS (PVC-RGS) conduit shall be used in corrosive areas where exposed to physical damage, or where specified on the plans.
5. Liquid-tight flexible metallic conduit, in lengths not exceeding 3 feet, shall be used to connect motors and transformers. Installation shall be such that considerable slack is realized. The conduit shall contain a separate grounding conductor.
6. Flexible metallic conduit shall be used in lengths not exceeding 6 feet. The conduit shall contain a separate grounding conductor. Connectors shall be steel or malleable iron.

- a. Reduced wall type shall be acceptable for connection of fire alarm, lighting fixtures, and wiring devices or equipment mounted in movable panels such as acoustical ceiling tiles, etc. Installation shall be such that considerable slack is realized. Factory supplied and listed lighting fixture whips are acceptable in lieu of flexible metallic conduit.
 - b. Full wall type shall be used for flexible connections in any area subject to physical damage.
- 7. Liquid-tight Flexible Metallic Conduit:
 - a. Food service areas requiring flexible connections - Splash zone, white NSF 169 compliant.
 - b. Healthcare Central Sterile, Lab, Pharmacies, and for imaging suites and Operating Rooms requiring flexible connections - Splash zone, white NSF 169 compliant.
 - c. Below computer floors - Computer Blue with extended UL performance testing.
 - d. Air plenums containing flexible connections - Low Smoke Zero Halogen Cable – Type LSZH.
 - e. Hi-Low temperature spaces, like cooler and freezers, requiring flexible connections – for Hi (up to 60°C wet/105°C dry) or Low temperature (down to -55°C) applications.
- 8. Liquid-tight Flexible Non-metallic Conduit (LFNC)
 - a. Use only where specifically called out on the plans, sub-configurations as described.
- 9. All other conduit shall be EMT. A separate insulated grounding conductor, sized per the NEC, shall be installed in EMT.
- B. Conduit shall be continuous from outlet to outlet, cabinet, or junction box, and shall be so arranged that wire may be pulled in with the minimum practical number of junction boxes.
- C. All conduit shall be concealed wherever possible. All conduit runs may be exposed in mechanical equipment rooms, electrical equipment rooms, and electrical closets, and where indicated on the drawings. No conduit shall be run exposed in finished areas without specific acceptance by the Architect.
- D. Exposed conduit shall be run in straight lines at right angles to or parallel with walls, beams, or columns. In no case shall conduit be supported or fastened to other pipes or installed to prevent the ready removal of other pipe.
- E. Where possible, all conduit for wiring within stud or moveable partitions shall enter the partition from above.
- F. Provide sleeves and chases where conduit passes through floors or walls as part of the work of this section. Core drilling will only be permitted where accepted by the Architect.
- G. Conduit stubbed up/down or through floor slabs shall be wrapped RGS or wrapped IMC with a minimum of 6 inches of conduit exposed out of slab for connection of threaded or compression fitting. Where conduit bends extend out of slab, the conduit shall be placed at the maximum allowable distance from the exit surface and shall have a bend radius as allowed by code to provide as true and square a conduit exit as possible. Conduit deck flanges will be used where conditions allow and where the flange can be tightly secured flush to the face of a concrete form.
- 1. Exception: Conduit stubbed through slabs on grade into the bottom of full height switchboard/switchgear sections, floor mounted full height UPS sections, floor mounted full height automatic transfer switches, floor mount transformers and load banks.

- H. Openings through fire-rated floors and fire walls through which conduit passes shall be sealed by fire stop material to seal off cold smoke and toxic fumes. Fire-seal material shall have an hourly fire rating equal to or higher than the fire rating of the floor or wall through which the cable or conduit passes. Material used shall conform to the Authority Having Jurisdiction (AHJ) requirements. Openings through smoke walls through which cable or conduit passes shall be sealed with non-shrink, non-combustible material approved by the AHJ to seal off cold smoke and toxic fumes.
- I. Conduit above lay-in grid-type ceilings shall be installed in such a manner that it does not interfere with the "lift-out" feature of the ceiling system.
- J. Conduit runs shall be installed to maintain the following minimum spacing wherever practical:
 - 1. Water and Waste Piping: Not less than 3 inches.
 - 2. Steam and Condensate Lines: Not less than 12 inches.
 - 3. Radiation and Reheat Lines: Not less than 6 inches.
- K. All underground conduit outside of any buildings shall be a minimum of 24 inches below finished grade, except where noted otherwise on the drawings.
- L. All underground feeder conduit (this does not include branch circuits) outside of any buildings shall be concrete encased. Concrete shall be 3/8-inch aggregate with a nominal compressive strength of 2,500 PSI. It shall have enough slump to flow to the bottom of the duct formation and not so wet as to cause the ducts to float. Each conduit shall be completely encased in concrete not less than 3 inches all around. Concrete shall not be poured until conduit has been inspected by the Architect. Separators or spacing blocks shall be made of plastic or other suitable non-metallic, non-decaying material placed on not greater than 5-foot centers. Ducts shall be anchored to prevent movement during placement of concrete.
- M. Provide corrosion protection for metallic conduit under concrete or in earth. Provide half-lap wrap of polyethylene 20-mil tape, factory PVC coating, or as accepted. Where PVC coating is provided, joints must be sealed in accordance with the coating manufacturer's published instructions.
- N. PVC-coated RGS (PVC-RGS) joints must be sealed in accordance with the coating manufacturer's published instructions. Installer shall be certified by the manufacturer and shall provide a valid, unexpired "Certified Installer" card prior to installing materials. Product manufacturer shall perform an inspection of the installed product and issue an acceptance report of the installation.
- O. Each empty conduit shall be provided with an installed nylon pull string.
- P. Each medical equipment conduit shall be provided with an installed calibrated pull string/measuring tape.
- Q. Bending: Changes in direction shall be made by bends in the conduit wherever possible, and these bends shall be made smooth and even without flattening the pipe or flaking the finish. Bends shall be of as long a radius as possible, but in no case less than shown in the NEC.
- R. Not more than four 90-degree bends will be allowed in one raceway run. Where more bends are necessary, a pull box shall be installed. All bends in 1-inch and smaller conduit shall be made with a conduit bender, and all larger conduit sizes shall have machine bends.

- S. Plastic conduit joints shall be made up in accordance with the manufacturer's recommendations for the particular conduit and coupling selected. Conduit joint couplings shall be made watertight. Plastic conduit joints shall be made up by brushing a plastic solvent cement on the inside of a plastic coupling fitting and on the outside of the conduit ends. The conduit and fitting shall then be slipped together with a quick one-quarter turn twist to set the joint tightly. Transition from plastic to steel conduit shall be with PVC female threaded adaptors.
- T. Plastic conduit shall be stored on a flat surface and protected from the direct rays of the sun.
- U. The ends of all conduit shall be securely plugged, and all boxes temporarily covered to prevent foreign material from entering the conduit. All conduit shall be thoroughly swabbed out with a dry swab to remove moisture and debris before conductors are drawn into place.

3.2 FITTINGS

- A. Bushings and Locknuts: Where conduit enters boxes, panels, cabinets, etc., it shall be rigidly clamped to the box by locknuts on the outside and inside, and a bushing on the inside of the box. All conduit shall enter the box squarely.
- B. Provide insulated bushings per the NEC on all conduit. The use of insulated bushings does not exclude the use of double locknuts to fasten conduit to the box.
- C. Provide expansion fittings for all conduit where it crosses building expansion joints, not to exceed 100 feet apart in straight runs. Fittings shall be complete with bonding jumpers and clamps and shall be suitably bonded to conduit.
- D. Provide weatherproof fittings in exterior installations or as noted on the plans.

3.3 SUPPORTS

- A. All raceways that are not buried or embedded in concrete shall be supported by straps, clamps, or hangers to provide a rigid installation.
- B. Conduit shall be supported at intervals required by the NEC, straight runs, at any bend, and at every outlet, junction box, panel, etc. This shall apply to vertical runs as well as horizontal runs. Where conduit is run individually, it shall be supported by approved conduit straps or beam clamps. Straps shall be secured by means of toggle bolts on hollow masonry; expansion shields and machine screws or standard preset inserts on concrete or solid masonry; machine screws or bolts on metal surfaces; and wood screws on wood construction. No perforated straps or wire hangers of any kind will be permitted. Where individual conduits are suspended from the ceiling, or above ceiling, they shall be supported by hanger rods and hangers. Conduit installed exposed in damp locations shall be provided with clamp backs under each conduit clamp, to prevent accumulation of moisture around the conduit. Where a number of conduits are to be run exposed and parallel, one with another, they shall be grouped and supported by trapeze hangers. Hanger rods shall be fastened to structural steel members with suitable beam clamps or to concrete inserts set through the opening provided in the concrete inserts. Beam clamps shall be suitable for structural members and conditions. Rods shall be galvanized steel, 3/8-inch diameter minimum. Each conduit shall be clamped to the trapeze hanger with conduit clamps.

3.4 GENERAL

- A. Install all boxes parallel and perpendicular to the finished floor. Adjust all flush mounting positions to compensate for wall material thickness. Where devices occur in the same horizontal viewing plane, align devices.

- B. Where outlet boxes occur on opposite sides of a common wall, do not place back-to-back or use through-the-wall boxes, to limit sound transmission between rooms.
- C. Where fire-rated walls occur, all membrane penetrations shall comply with the International Building Code (IBC) for walls/partitions, and for floor-ceilings/roof-ceilings. Outlet boxes in rated walls shall be steel. Outlet boxes on opposite sides of a rated wall shall be separated by a minimum of 24 inches horizontally.
- D. Support all boxes independently of conduit, except cast type which may be supported by rigid steel conduit only. Secure flush-mount boxes to wall and interior partition studs using stamped steel bridges as required to accurately position boxes. Secure ceiling-hung boxes to adjustable steel channel fasteners.
- E. All cabinets and boxes shall be secured by means of toggle bolts on hollow masonry; expansion shields and machine screws or standard precast inserts on concrete or solid masonry; machine screws or bolts on metal surfaces; and wood screws on wood construction. All recessed wall- and ceiling-mounted outlet boxes shall be supported by bar supports extending from the studs or channels on either side of the box. Boxes mounted on the surface of drywall or plaster shall be secured to wall or ceiling with fasteners rated for the weight to be supported, minimum 50 lbs. per fastener.
- F. Boxes with unused punched-out openings shall have the openings filled with factory-made knockout seals.
- G. Where emergency power and normal power are located in the same outlet box or a potential of 480 volts is present in a switch box, install partition barriers to separate the various systems.

3.5 TV / MONITOR BOXES

- A. Install boxes level, parallel, and perpendicular to the finished floor and walls, respectively. Adjust all finish trims tight to the respective wall finish material.
- B. Integrate adjacent low-voltage devices serving TV/monitor equipment within the common box. Adjust box size to accommodate both line-voltage and low-voltage devices. Provide appropriate activation plates and compartment barriers.
- C. Coordinate mounting height with architectural elevations and adjust to permit the installation of TV/monitor mounting brackets. Box shall remain behind the silhouette of the TV/monitor equipment.

3.6 FLOOR BOXES AND RECESSED MULTI-SERVICE FLOOR BOXES

- A. Install boxes level, parallel, and perpendicular to the finished floor and walls, respectively. Adjust all finish trims tight to the respective floor material.
- B. Provide pre-pour support below each box consisting of 1-inch-thick concrete pad, size as needed.
- C. Provide a minimum of 1-inch-thick concrete cover over all portions of recessed box body. Provide additional thickness as required by the box manufacturer.
- D. Boxes or floor pockets installed in a slab-on-grade configuration shall include corrosion protection as recommended by the box manufacturer.

3.7 SEPARATE CONDUIT SYSTEMS

- A. Each system shall be contained in a separate conduit system. This includes each power system, lighting system, signal system of whatever nature, telephone, emergency system, emergency subsystems, sound system, control system, fire alarm system, etc.
- B. Each item of building equipment shall have its own run of power wiring. Control wiring may be included in properly sized conduit for equipment feeders of #6 AWG and smaller, but separate conduits shall be used for larger size feeders.

3.8 ROUTING AND EXPOSURE

- A. Where conduit and boxes must be exposed, submit a sketch of the proposed route to the Architect for approval prior to installation.
- B. Where conduit is exposed to exterior ambient temperatures for more than 10% of its length or 10 feet, whichever is less, increase the conductor sizes in accordance with the application of ambient temperature factors contained in NEC Table 310.15.
- C. Conduit shall be installed at depths compliant with NEC Table 300.5.

END OF SECTION

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SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes:
 - 1. Identification for raceways.
 - 2. Identification of power and control cables.
 - 3. Identification for conductors.
 - 4. Warning labels and signs.
 - 5. Instruction signs.
 - 6. Equipment identification labels.
 - 7. Miscellaneous identification products.

1.2 ACTION SUBMITTALS

- A. Product Data: For each electrical identification product indicated.

1.3 QUALITY ASSURANCE

- A. Comply with ANSI A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1.
- B. Comply with NFPA 70.
- C. Comply with ANSI Z535.4 for safety signs and labels.
- D. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

- F. Differential values in Temperature Change subparagraph below (for aluminum in particular) are suitable for most of the United States.

1. Temperature Change: 120°F (67°C), ambient; 180°F (100°C), material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways Carrying Circuits at 600 Volts or Less:

1. Conduit shall be identified with field-installed self-adhesive labels in system color as stated below. Labels shall be the system color with a contrasting text color of white or black to promote visibility.

<u>System</u>	<u>Color</u>
Power – Normal System	No color (galvanized)
Emergency Power – All Systems	Orange

2. Conduits for future use shall be “No color” except where the future system is identified.

2.3 LABELS

- A. Write-On Tags: Polyester tag, 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by tag manufacturer.

- B. Adhesive Film Label with Clear Protective Overlay: Machine-printed, in black or white (as appropriate based on background color), by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

- C. Self-Adhesive Labels: Polyester Vinyl, thermal, transfer-printed, 3-mil (0.08-mm) -thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Minimum Nominal Size:
 - a. 1-1/2" x 6" (37 mm x 150 mm) for raceway and conductors.
 - b. 3-1/2" x 5" (76 mm x 127 mm) for equipment.
 - c. As required by Authorities Having Jurisdiction.

2.4 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Self-Adhesive Vinyl Labels: Preprinted flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

- B. Write-On Tags: Polyester tag, 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by tag manufacturer.
- C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
 - D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid colored acrylic sleeve 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
 - E. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.
 - F. Marker Tapes: Vinyl or vinyl cloth, self-adhesive wraparound type, with circuit identification legend machine-printed by thermal transfer or equivalent process.
- 2.5 FLOOR MARKING TAPE
- A. 2-inch (50-mm) wide, 5-mil (0.125 mm) pressure-sensitive vinyl tape, with black and yellow stripes and clear vinyl overlay.
- 2.6 INSTRUCTIONAL SIGNS
- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq.in. (129 sq.cm) and 1/8 inch (3.2 mm) thick for larger sizes.
 1. Engraved legend with black letters on white face.
 2. Punched or drilled for mechanical fasteners, minimum one per corner.
 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
- 2.7 EQUIPMENT IDENTIFICATION LABELS
- A. Engraved, Laminated Acrylic or Melamine Label: Minimum letter height shall be 3/8 inch (10 mm). Punched or drilled for mechanical fasteners, two minimum.
 - B. First line of text shall include the equipment name assigned on the floor plans. Second line of text is equipment-specific.
 1. Switchboards, panelboards, motor control centers, and disconnects shall include ampere rating, voltage, phase, 3- or 4-wire, and upstream source "fed from (name as appropriate)."
 2. Wireways shall include ampere upstream source "fed from (name as appropriate)."
 3. Transformers shall include kVA, voltage, phase, 3- or 4-wire, and upstream source "fed from (name as appropriate)."
 4. Generators and UPSs shall include kW and kVA rating, voltage, phase, 3- or 4-wire, and system type; Life Safety, Critical, Equipment, Fire Pump, System-A, NEC 700, NEC 701, NEC 702, etc.
 5. Transfer switches shall include ampere rating, voltage, phase, 3- or 4-wire, and on a third and fourth line of text upstream sources "Normal fed from (name as appropriate)" and "Emergency fed from (name as appropriate)."
 6. Lighting controls and relay panels shall include name of general area served; Classroom Bldg. B, 1st Floor, 2nd Floor West, etc.

C. Colors:

1. Normal Power: White letters on black face.
2. Emergency Power: White letters on orange face.

2.8 DEVICE CIRCUIT IDENTIFICATION LABELS

- A. Adhesive Film Label with Clear Protective Overlay: Machine-printed by thermal transfer or equivalent process. Minimum letter height shall be 1/4 inch (6 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

B. Text Colors:

1. Black text for normal power systems.
2. Red text for emergency or essential power systems.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: For paint materials and application requirements, comply with requirements in specification sections under 09 90 00, Painting and Coating. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws, stainless-steel machine screws with nuts and flat and lock washers, or stainless steel rivets.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. For instance, vertically mounted boxes or equipment labels shall read horizontally.
- B. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- C. 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 & Maintenance Manual. Use consistent designations throughout project.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. Signs and plastic labels shall be attached with mechanical fasteners appropriate to the location and substrate.

- H. 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.
- I. Write-on tags shall be used for temporary identification of conductor and cable only. Each tag shall be changed to a permanent solution prior to project closeout.
- J. System Identification for Raceways and Cables under 600 Volts: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
 - 1. Locate conduit labels at changes in direction, at penetrations of walls and floors, at 30-foot maximum intervals in straight runs.
 - 2. Raceway system junction boxes shall be painted to match system color. On junction boxes that are larger than 25 inches square, only the cover of the box need be painted.
 - 3. Locate conductor and cable circuit number labels within 9 inches of terminations and at each pull box interior.
 - 4. Secure identifications tight to surface of conductor, cable, or raceway.
- K. Painted Identification: For surface preparation and paint application, comply with requirements in specification sections under 09 90 00, Painting and Coating.
- L. 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.
- M. Equipment Identification Labels: On each unit of equipment, install a unique designation label that is consistent with design plans, wiring diagrams, schedules, and the Operation & Maintenance Manual. Apply labels to switchboards, panelboards, motor control centers, lighting control panels, relay panels, transformers, disconnects, wireways, generators, transfer switches, UPSs, control cabinets, and racks.
 - 1. Labeling Instructions:
 - a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 3/8-inch (10-mm) -high letters on 1-inch (25-mm) -high label; where two lines of text are required, use labels 1-1/2 inches (38 mm) high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 3/8-inch (10-mm) -high letters on 1-inch (25-mm) -high label; where two lines of text are required, use labels 1-1/2 inches (38 mm) high.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - d. Fasten labels with appropriate mechanical fasteners that do not change the NEMA or nationally recognized testing laboratory (NRTL) rating of the enclosure.

3.2 IDENTIFICATION SCHEDULE

- A. Equipment Identification: Identify each piece of electrical equipment as described in this section.
- B. Junction boxes recessed in walls or ceilings shall be color-coded on the interior to match the raceway system color-code.

- C. Accessible Raceways and Cables Within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall match the raceway color-coding descriptions in Part 2 and shall have either dark text over light box color or light text over dark box color, as appropriate.
- D. Metal-Clad Cables, 600 Volts or Less, for Circuits More than 30 Volts, and up to 277 Volts to Ground: Install labels within 3 feet of termination.
- E. Power-Circuit Conductor Identification, 600 Volts or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
 - 1. Color-Coding for Phase and Voltage Level Identification, 600 Volts or Less: Use colors listed below for ungrounded conductors.
 - a. Color shall be factory applied or field applied for sizes larger than #8 AWG, if Authorities Having Jurisdiction permit.
 - b. Colors for 208/120-Volt Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - c. Colors for 480/277-Volt Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - d. 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.
- F. Wiring Device Circuit Identification: Circuits supplying devices shall be identified on the device trim plate, panel-circuit number format.
- G. Conductors and Conduit to be Extended in the Future: Attach marker tape to conductors and conduit and list source.
- H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with project drawings, manufacturer's wiring diagrams, and the Operation & Maintenance Manual.

- I. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Outline NEC horizontal workspace requirements per NEC 110.26 Table for the applicable condition. Workspace width shall be the length of electrical equipment or 30 inches centered on equipment, whichever is greater.

END OF SECTION

Edition: 2008-2201

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SECTION 26 09 23

LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install occupancy sensors and related power packs, daylighting sensors and related power packs, intelligent relays, emergency relays, timer switches, and sensor related wall switches, as shown on the drawings and as specified herein.
- B. Contractor shall coordinate all of the work in this section with all of the trades covered in other sections of the specification to provide a complete and operable system.

1.2 REFERENCES

- A. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE).
- B. Underwriters Laboratories of Canada (ULC).
- C. International Electrotechnical Commission (IEC).
- D. International Organization of Standardization (ISO).
- E. National Electrical Manufacturers Association (NEMA).
- 1. WD1 (R005) - General color requirements for wiring devices.

1.3 QUALITY ASSURANCE

- A. Firms regularly engaged in the manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. All components and assemblies are to be factory pretested and burned-in prior to installation.
- C. Factory-trained technicians shall be available to functionally test each component in a programmable system after installation to verify proper operation and confirm that the panel wiring and addressing conform to the wiring documentation.
- D. System Support: Factory Applications Engineers shall be available for on-site training as well as telephone support.
- E. Comply with the NEC as applicable to electrical wiring work.
- F. Comply with applicable portions of NEMA Standards pertaining to types of electrical equipment and enclosures.
- G. All components shall be UL listed as a system under UL 916, Energy Management Equipment.

- H. All assemblies are to be in compliance with FCC Emissions Standards specified in Part 15, Subpart J, for Class A application.

1.4 SUBMITTALS

- A. Submit manufacturer's product data for the lighting control devices and components. This shall include catalog sheets, specifications, and installation instructions.
- B. Submit dimensioned shop drawings at a minimum of 1/8" = 1'-0" scale indicating the location of all lighting control components and accessories.
- C. Submit typical wiring diagrams for all components, including, but not limited to, input devices such as low-voltage switches, vacancy and occupancy sensors, daylighting sensors, photocells, power packs, emergency control relays, and cable/wire.

1.5 GUARANTEE

- A. Provide a 5-year manufacturer's warranty on all products to be free of manufacturer's defects. In addition to the replacement parts, this warranty shall include replacement labor.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of design is Wattstopper. Product reference numbers contained herein are for standard products offered by Wattstopper. Subject to compliance with requirements, equivalent products from manufacturers listed below are acceptable.
 - 1. Greengate.
 - 2. Hubbell Control Solutions.
 - 3. LC & D.
 - 4. Leviton.
 - 5. Lutron.
 - 6. Philips.

2.2 GENERAL

- A. Sensor control shall utilize Zero Crossing Circuitry.
- B. Sensor shall have no leakage current to load, in Manual or in Auto/Off mode, and shall have voltage-drop protection.
- C. Sensor shall provide a field selectable option to convert sensor operation from Automatic-ON to Manual-ON.
- D. Where specified to be vandal-resistant type, sensor shall utilize a hard lens with a minimum 1.0 mm thickness. Products utilizing a soft lens will not be considered.
- E. Sensors shall have UL rated, 94V-0 plastic enclosures.
- F. Passive infrared sensors shall utilize Pulse Count Processing and Detection Signature Processing to respond only to those signals caused by human motion.

- G. Passive infrared sensors shall provide high immunity to false triggering from RFI (hand-held radios) and EMI (electrical noise on the line).
- H. Passive infrared sensors shall have a multiple segmented Fresnel lens, in a multiple-tier configuration, with grooves-in to eliminate dust and residue build-up.
- I. Where specified, passive infrared, ultrasonic, and dual technology dual relay sensors shall offer daylighting footcandle adjustment control.
- J. Dual technology sensors shall consist of passive infrared and ultrasonic/microphonic technologies for occupancy detection. Products that react to noise or ambient sound shall not be considered.
- K. Ultrasonic/microphonic sensors shall utilize Advanced Signal Processing to adjust the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space.
- L. Ultrasonic/microphonic operating frequency shall be crystal controlled at 25 kHz within $\pm 0.005\%$ tolerance, 32 kHz within $\pm 0.002\%$ tolerance, or 40 kHz $\pm 0.002\%$ tolerance to assure reliable performance and eliminate sensor cross-talk. Sensors using multiple frequencies are not acceptable.
- M. Sensors shall be capable of operating normally with electronic ballasts, PL lamp systems, and rated motor loads.
- N. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioner or heating fans.
- O. When specified, sensors shall utilize intelligent technology to automatically adjustable time delay and sensitivity settings.
- P. Sensors shall have readily accessible, user adjustable settings for time delay and sensitivity. Settings shall be located on the sensor (not the control unit) and shall be recessed to limit tampering.
- Q. Bypass: In the event of failure, a manual relay override shall be provided on each sensor. When override is utilized, lighting shall remain on constantly or control shall divert to a wall switch until the sensor is replaced. This control shall be recessed to prevent tampering.
- R. Sensors shall provide an LED which is responsive to presence of motion. This indicator shall be visible at all times, both in testing and normal operation.
- S. HVAC Interface: Where specified, the sensor shall have an internal isolated relay with Normally Open/Normally Closed outputs for use with HVAC Control, Data Logging, and other control options. Sensors utilizing separate components or specially modified units to achieve this function are not acceptable.
- T. HID Controller shall:
 - 1. Be compatible with all types of High Intensity Discharge (HID) lamps, including Metal Halide, Metal Halide Pulse Start, and High Pressure Sodium.
 - 2. Operate with HID lamps utilizing Constant Wattage Autotransformer (CWA) type ballasts.
 - 3. Maintain a full light level during lamp warmup for 15 minutes. Purpose: To avoid lamp damage during the HID power-up period.

4. Be compatible with any 24-VDC controlling device, such as occupancy sensors, time switches, control panels, or photocells. Purpose: To maximize lighting control scenarios.
5. Be capable of linking to other HID control modules to enable effective multi-zone control. Up to 100 individual devices shall be capable of being connected.

2.3 WALL SENSOR SWITCH

- A. UW-100 Series ultrasonic/microphonic technology, single relay, line-voltage sensor. Sensor shall be capable of detection of occupancy at desktop level up to 225 square feet.
 1. Sensor contacts shall have ratings of:
 - a. 800-W, 120-VAC ballast or tungsten.
 - b. 1/6-HP, 230 to 277-VAC motor.
 - c. 1,200-W, 277-VAC ballast.
 2. Sensor features shall include:
 - a. Sensitivity Adjustments: Ultrasonic/Microphonic – continuous.
 - b. Time Delays: Auto Set, Fixed (5, 10, 15, 20, 25, 30 minutes), Walk Through, and Test Mode.
- B. UW-200 Series ultrasonic/microphonic technology, dual relay, line-voltage sensor. Sensor shall be capable of detection of occupancy at desktop level up to 225 square feet.
 1. Sensor contacts shall have ratings of:
 - a. 800-W, 120-VAC ballast or tungsten.
 - b. 1/6-HP, 230 to 277-VAC motor.
 - c. 1,200-W, 277-VAC ballast.
 2. Sensor features shall include:
 - a. Sensitivity Adjustments: Ultrasonic/Microphonic – continuous.
 - b. Time Delays: Auto Set, Fixed (5, 10, 15, 20, 25, 30 minutes), Walk Through, and Test Mode.
- C. DW-100 Series dual technology, single relay, line-voltage sensor. Sensor shall be capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1,000 square feet.
 1. Sensor contacts shall have ratings of:
 - a. 800-W, 120-VAC ballast or tungsten.
 - b. 1/6-HP, 230 to 277-VAC motor.
 - c. 1,200-W, 277-VAC ballast.
 2. Sensor features shall include:
 - a. Sensitivity Adjustments: PIR-High/Low, Ultrasonic/Microphonic – continuous.
 - b. Time Delays: Auto Set, Fixed (5, 15, 30 minutes), Walk Through, and Test Mode.

- D. DW-200 Series dual technology, dual relay, line-voltage sensor. Sensor shall be capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1,000 square feet.
1. Sensor contacts shall have ratings of:
 - a. 800-W, 120-VAC ballast or tungsten.
 - b. 1/6-HP, 230 to 277-VAC motor.
 - c. 1,200-W, 277-VAC ballast.
 2. Sensor features shall include:
 - a. A light level sensor to active second relay of dual relay switch.
 - b. Sensitivity Adjustments: PIR-High/Low, Ultrasonic/Microphonic – continuous.
 - c. Time Delays: Auto Set, Fixed (5, 15, 30 minutes), Walk Through, and Test Mode.
- E. PW-200 Series PIR, dual relay, line-voltage sensor. Sensor shall be capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1,000 square feet.
1. Sensor contacts shall have ratings of:
 - a. 800-W, 120-VAC ballast or tungsten.
 - b. 1/6-HP, 230 to 277-VAC motor.
 - c. 1,200-W, 277-VAC ballast.
 2. Sensor features shall include:
 - a. A light level sensor to active second relay of dual relay switch.
 - b. Sensitivity Adjustments: PIR-High/Low, Ultrasonic/Microphonic – continuous.
 - c. Time Delays: Auto Set, Fixed (5, 15, 30 minutes), Walk Through, and Test Mode.

2.4 WALL SWITCH ELECTRONIC TIME SWITCHES (DIGITAL)

- A. TS-400 Series digital time switch shall be wall box type, single gang, rated 120 volts, 800 watts, and 277 volts, 1,200 watts. The switch shall include a Manual Switch On, automatic function to turn lights off after a preset elapsed time, and a user temporary time override without changing the preset off. Automatic Off function shall be adjustable from 5 minutes to 12 hours. Prior to extinguishing the lights, the switch shall provide a visual and audible warning to allow occupants to reset as needed.

2.5 WALL SWITCH SPRING-WOUND TIMER

- A. Intermatic FF Series or as accepted. Spring-wound time switch shall be quiet mechanical type, specification grade, 20 amps, 125 volts AC, 1 HP at 120 volts AC, 2 HP at 250 Volts AC, 10 amps at 277 Volts AC, 1-hour duration (unless noted otherwise on the drawings), without hold feature.

2.6 CEILING MOUNT SENSORS

- A. CI-300 Series PIR sensor shall utilize low-voltage for control and include the companion single or dual level relay power pack/control unit. Sensor shall surface mount to a standard 4-inch octagon electrical back box. Provide manufacturer-recommended companion wall switch(es) for Manual Enable/Disable operation.

- B. DT-300 Series dual technology sensor shall utilize low-voltage for control and include the companion single or dual level relay power pack/control unit. Sensor shall surface mount to a standard 4-inch octagon electrical back box. Provide manufacturer recommended companion wall switch(es) for manual enable/disable operation.
- C. UT-300 Series Ultrasonic sensor shall utilize low-voltage for control and include the companion single or dual level relay power pack/control unit. Sensor shall surface mount to a standard 4-inch octagon electrical back box. Provide manufacturer-recommended companion wall switch(es) for Manual Enable/Disable operation.

2.7 CORNER MOUNT SENSORS

- A. DT-200 Series dual technology sensor shall utilize low-voltage for control and include the companion single or dual level relay power pack/control unit. The sensor shall have an adjustable corner mount housing allowing placement as depicted on plans. Provide manufacturer-recommended companion wall switch(es) for Manual Enable/Disable operation.
- B. CX-100 Series PIR sensor for corridors and aisles (warehouse of similar) only. This sensor shall utilize low-voltage for control and include the companion single or dual level relay power pack/control unit. The sensor shall have an adjustable corner mount housing allowing placement as depicted on plans. Provide manufacturer-recommended companion wall switch(es) for manual enable/disable operation.

2.8 EXTERIOR MOUNTED SENSORS

- A. EW-Series exterior sensors shall cover 35' to 52.5' radiuses, with a field of view of 180 to 270 degrees respectively.
- B. EN-100 exterior sensor shall cover up to 35 foot radius, with a field of view of 90 degrees.
- C. EN 200 exterior sensors shall cover up to 100 feet, with a long-range lens view.
- D. EWF exterior sensors shall include polycarbonate lamp holders that accept PAR 20 or 38 lamps up to 150 watts per lamp.
- E. Exterior sensors shall have UL 773A ratings. EWF exterior sensors shall additionally have UL 1571 ratings.
- F. Exterior sensors shall be manufactured with precision tooling and contain internal silicon gaskets and have an operating temperature range of -40°F to +130°F.

2.9 RELAY POWER PACK/CONTROL UNITS

- A. BZ Series relay power pack/control unit shall be able to be externally mounted through a 1/2-inch knockout on a standard electrical enclosure. The unit shall be integrated, self-contained, and consist of an internally isolated load switching control relay and a transformer to provide low-voltage power. The unit shall include single or dual relays as per the control requirements, and shall provide power to a minimum of two sensors. Housing shall be plenum rated.
- B. Relay contacts shall have ratings of:
 1. 20 amps – 120/230/277-VAC ballast or incandescent.
 2. HP – 120/230/277-VAC motor.

2.10 EMERGENCY RELAY PACK/CONTROL UNIT

- A. ELCU Series emergency relay pack/control unit shall be designed to provide emergency override control (bypass) of normal power control of emergency circuit when the power to the normal power circuit is removed, UL 924 listed. The unit shall be able to be externally mounted through a 1/2-inch knockout on a standard electrical enclosure. The unit shall be integrated, self-contained, and consist of an internally isolated load switching control relay and a transformer to provide low-voltage power. The unit shall include single or dual relays as per the control requirements, and shall provide power to a minimum of two sensors. Housing shall be plenum rated.
- B. Relay contacts shall have ratings of:
 - 1. 10 amps – 120-VAC incandescent.
 - 2. 1.0 HP – 120-VAC motor.
 - 3. 20 amps – 120/277-VAC ballast.

2.11 INTELLIGENT RELAY POWER PACK/CONTROL UNITS

- A. LC-100 Series intelligent power pack/control unit shall be a separately mounted enclosure containing four points of control: Two 0 to 10-volt dimming, two relays. Control inputs can be on/off switches, daylighting photosensor, external time controller contacts, and load shedding system contacts. The unit shall consist of internally isolated load switching control relays, each with an isolated NO/NC contact set. Unit shall include a transformer to power up to 150 mA of low-voltage devices. Pair with LS-301 photosensor for daylighting control. Housing shall be plenum rated.
- B. Relay contacts shall have ratings of:
 - 1. 20A – 120/277-VAC ballast or incandescent.
 - 2. HP – 120/250-VAC motor.

2.12 PHOTOSENSORS

- A. LS-301 Series photosensor, closed loop type, shall provide full range dimming, 0.2 to 10 VDC output voltage, and control up to 50 dimming ballasts in one zone. Provide sensor with remote control for setup and user control. Sensor shall be ceiling surface mount.
- B. LS-102 Series switching photosensor, closed loop type, shall provide on-off control in conjunction with occupancy sensor and related relay power pack/control unit. Sensor shall be ceiling surface mount.
 - 1. Features:
 - a. Auto Setpoint Calculation.
 - b. Multi-Band Photosensor Range: 1 to 1,400 fc.
 - c. On Setpoint Range: 1 to 850 fc.
 - d. Status Indicator: Multi-function green LED.

2.13 CONTROL WIRING

- A. Control wiring between sensors and control units shall be Class II, #18-24 AWG, stranded UL classified, PVC insulated or Teflon jacketed cable suitable for use in plenums, where applicable. Minimum acceptable wire gauge from the circuit control hardware relays shall be #14 AWG.

PART 3 - EXECUTION

3.1 PRE-INSTALLATION COORDINATION

- A. A factory-authorized manufacturer's representative shall provide the Electrical Contractor a functional overview of the lighting control system prior to installation. The Contractor shall schedule the pre-installation site visit after receipt of approved submittals to review the following:
 - 1. Confirm the location and mounting of all devices, with special attention to placement of occupancy and daylighting sensors.
 - 2. Review the specifications for low-voltage control wiring and termination requirements.
 - 3. Discuss the functionality and configuration of all products, including sequences of operation, per design requirements.
 - 4. Discuss requirements for integration with other trades and specific responsibilities regarding integration.
- B. Manufacturer's representative to provide written or computer-generated documentation for use in commissioning activities on a room-by-room basis including:
 - 1. Sensor parameters, time delays, sensitivities, daylighting setpoints.
 - 2. Sequence of operations, manual on, auto off, etc.
- C. Do not install equipment until the following conditions can be maintained in spaces to receive equipment:
 - 1. Ambient Temperature: 0 to 40°C (32 to 104°F).
 - 2. Relative Humidity: Maximum 90%, non-condensing.

3.2 INSTALLATION

- A. Provide detailed point-to-point wiring diagrams for every termination. Provide color-coded conductors to simplify Contractor termination requirements, where using building wiring. Color codes shall be noted on the diagrams.
- B. Provide wiring in accordance with the equipment manufacturer's wiring diagrams.
- C. Mount devices according to the project requirements and the equipment manufacturer's recommendations. Sensors shall be mounted in such a way as to minimize coverage in unintended areas.
- D. Switch and Relay Type: Provide single or dual relay control to match the lighting system installed in the room controlled.
- E. Sensor Type Applications:
 - 1. PIR sensors shall be provided in single occupancy offices, up to 300 square feet.
 - 2. Dual technology sensors shall be provided in single person restrooms (no stalls).
 - 3. Ultrasonic/Microphonic sensors shall be provided in other restrooms.
 - 4. PIR sensors shall be used in aisles (warehouse or similar).
 - 5. Dual technology sensors shall be provided in other spaces.
- F. Where no ceilings are utilized, conduit must be routed from a back box at the device back to a connection point at the nearest lighting fixture or control location.

3.3 DAYLIGHTING SENSORS AND CONTROLS

- A. Install and calibrate per manufacturer's recommendations. Adjust the daylighting sensor to provide even illumination between on/off sequences. The time delay shall provide adequate "dead band" to allow the passing of clouds without triggering the electric lighting off.
- B. At night with no exterior illumination except moonlight, measure and record the installed electric lighting illumination level at the floor or at the desk (at regularly occupied environments) within the daylighting zone. Set the sensor target level at the nearest increment above the measured electric lighting illumination level.

3.4 FIELD STARTUP AND COMMISSIONING

- A. Upon completion of the installation, the system shall be commissioned by the manufacturer's factory-authorized representative who will verify a complete, fully functional system. Representative shall work with the Electrical Contractor to adjust each device to operate within the manufacturer's expectations for the product.
 - 1. Calibrate all sensor time delays and sensitivity for proper coverage of occupants and for energy savings.
 - a. Adjust time delay so that controlled area remains lighted for 5 minutes after occupant leaves area.
- B. The manufacturer's representative and the Contractor shall walk the project with the Owner to demonstrate sensor functions. Contractor shall provide both the manufacturer and the Owner with 10 working days written notice of the demonstrative project walk. The Contractor shall make adjustments to sensor operations to satisfy the Owner's needs within the parameters of the sensor and the applicable energy code requirements.
- C. Upon completion of the system commissioning, the factory-authorized technician shall provide 2 hours of training to the Owner's designated personnel on the adjustment and maintenance of each type of component.

3.5 RE-COMMISSIONING

- A. Re-commission project at 30 days from occupancy, recalibrate all sensor time delays and sensitivities to meet the Owner's project requirements. Provide a detailed report to the Architect/Owner of re-commissioning activity.

END OF SECTION

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SECTION 26 09 25

LIGHTING CONTROL DEVICES (DIGITAL OCCUPANCY & DAYLIGHT MANAGEMENT SYSTEM)

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Digital Occupancy and Daylighting Sensor Control.
2. Emergency Lighting Control (if applicable).

B. Reference relevant specification sections in Division 26 for additional requirements.

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specifications, apply to this section.

C. Control Intent: Control intent includes, but is not limited to:

1. Defaults and initial calibration settings for such items as time delay, sensitivity, fade rates, etc.
2. Initial sensor and switching zones.
3. Initial time switch settings.
4. Task lighting and receptacle controls.
5. Emergency lighting control (if applicable).

1.2 REFERENCES

A. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE).

B. Underwriters Laboratories of Canada (ULC).

C. International Electrotechnical Commission.

D. International Organization of Standardization (ISO).

E. National Electrical Manufacturers Association (NEMA).

1. WD1 (R005) - General Color Requirements for Wiring Devices.

F. Underwriters Laboratories, Inc. (UL):

1. 916 - Energy Management Equipment.
2. 924 - Emergency Lighting.

1.3 SYSTEM DESCRIPTION & OPERATION

- A. The lighting control and automation system as defined under this section covers the following equipment:
1. Digital Room Controllers: Self-configuring, digitally addressable, one-, two- or three-relay controllers with 0 to 10-volt control for ballasts (if applicable) and single relay application specific plug load controllers.
 2. Digital Occupancy Sensors: Self-configuring, digitally addressable, and calibrated occupancy sensors with LCD screens and two-way active infrared (IR) communications.
 3. Digital Switches: Self-configuring, digitally addressable pushbutton switches, dimmers, and scene switches with two-way active infrared (IR) communications.
 4. Analog and Digital Closed Loop Daylighting Sensors: Self-calibrating daylighting sensors that provide closed loop control to room controllers. Sensors and room controllers can provide single- or multi-zone, on/off, or dimming control for daylight harvesting.
 5. Handheld Remotes for Room Configuration: Provides two-way infrared communications to digital devices and allows complete configuration and reconfiguration of the device/room from 30 feet away. Unit to have Organic LED display, simple pushbutton interface, and allow send/receive/store of room variables.
 6. Handheld Remotes for Personal Control: One-, two-, or four-scene button remotes provide infrared communications to a room. Remote controls will support On/Off, dimming, scene control and may be configured in the field to provide specific occupant requirements without special tools.
 7. Digital Lighting Management (DLM) Local Network: Free topology, plug-in wiring system (CAT 5e) for power and data to room devices.
 8. Native BACnet® Module (if applicable): Provide MS/TP communications for room-to-room or room-to-server communications.
 9. Emergency Lighting Control Unit (ELCU): Allows any standard lighting control device to control emergency lighting in conjunction with normal lighting in any areas within a building.

1.4 LIGHTING CONTROL APPLICATIONS

- A. Unless relevant provisions of the applicable local Energy Codes are more stringent, provide a minimum application of lighting controls as follows:
1. Space Control Requirements: Provide occupancy/vacancy sensors with Manual On functionality in all spaces except toilet rooms, storerooms, library stacks, or other applications where hands-free operation is desirable and Automatic On occupancy sensors are more appropriate. Provide Manual On occupancy/vacancy sensors for any enclosed office, conference room, meeting room, open plan system, and training room. For spaces with multiple occupants or where line-of-site may be obscured, provide ceiling- or corner-mounted sensors with Manual On switches.
 2. Bi-Level Lighting: Provide multi-level switched dimming controls in all spaces except toilet rooms, storerooms, library stacks, or applications where variable dimming is used.
 3. Task Lighting/Plug Loads: Provide Automatic Shutoff of non-essential plug loads and task lighting in all spaces except toilet rooms and storerooms. Provide Automatic On of plug loads whenever spaces are occupied. For spaces with multiple occupants, a single shutoff consistent with the overhead lighting may be used for the area.
 4. Daylighted Areas: All luminaires within 15 feet of windows or within 7 feet of skylights (the daylighted zone) shall be separately controlled from luminaires outside of daylighted zones. Luminaires closest to the daylight aperture shall be separately controlled from luminaires farther from the daylight aperture, within the daylight zone.
 5. Daytime setpoints for total illumination (combined daylight and electric light) level that initiate dimming shall be programmed to be not less than 125% of the nighttime maintained designed illumination levels.

6. Multiple leveled switched daylight harvesting controls may be utilized for areas marked on the drawings.
7. Provide smooth and continuous daylight dimming for areas marked on the drawings. Daylight system may be designed to turn off ambient lighting when daylight is at or above required lighting levels, only if system functions to turn lamps back on at dimmed level, rather than turning full on prior to dimming.

B. Additional Controls:

1. Provide occupancy/vacancy sensors for any enclosed office, conference room, meeting room, and training room. For spaces with multiple occupants or where line-of-site may be obscured, provide ceiling- or corner-mounted with Manual On switches.
2. Conference, meeting, training, auditoriums, and multi-purpose rooms shall have controls that allow for independent control of each local control zone. Rooms larger than 300 square feet shall instead have at least four preset lighting scenes unless otherwise specified. Occupancy/vacancy sensors shall be provided to extinguish all lighting in the space.

1.5 SUBMITTALS

- A. Submittals Package: Submit the shop drawings, and the product data specified below at the same time as a package.
- B. Shop Drawings (for Sensor Systems):
 1. Composite wiring and/or schematic diagram of each control circuit as proposed to be installed (standard diagrams will not be accepted).
 2. Scale drawing for each area showing exact location of each sensor, switching module, and On-Off-Auto switch.
- C. Product Data: Catalog sheets, specifications, and installation instructions.
- D. Include data for each device which:
 1. Indicates where sensor is proposed to be installed.
 2. Provides that the sensor is suitable for the proposed application.

1.6 QUALITY ASSURANCE

- A. Manufacturer: Minimum 10 years' experience in manufacture of lighting controls.

1.7 PROJECT CONDITIONS

- A. Do not install equipment until following conditions can be maintained in spaces to receive equipment:
 1. Ambient Temperature: 0 to 40°C (32 to 104°F).
 2. Relative Humidity: Maximum 90%, non-condensing.

1.8 WARRANTY

- A. Provide a 5-year complete manufacturer's warranty on all products to be free of manufacturer's defects.

1.9 MAINTENANCE

- A. Spare Parts: Provide 5% of each product to be used for maintenance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer:

- 1. Wattstopper:
 - a. System: Digital Lighting Management (DLM).
- 2. Basis of Design Product: Wattstopper digital lighting management (DLM) or subject to compliance with prior approval with specified requirements of this section, one of the following:
 - a. Douglas.
 - b. General Electric.
 - c. Greengate.
 - d. LC&D.
 - e. Leviton.
 - f. Lutron.
 - g. Micro-Lite.
 - h. Philips.
 - i. Wattstopper.
 - j. Approved equal.

- B. Substitutions:

- 1. All proposed substitutions (clearly delineated as such) must be submitted in writing for approval by the design professional a minimum of 10 working days prior to the bid date and must be made available to all bidders. Proposed substitutes must be accompanied by a review of this specification noting compliance on a line-by-line basis.
- 2. By using pre-approved substitutions, the Contractor accepts responsibility and associated cost for all required modifications to circuitry, devices, and wiring. The Contractor shall provide complete engineered shop drawings (including power wiring) with deviations for the original design highlighted in an alternate color to the Engineer for review and approval prior to rough-in.

2.2 SINGLE/DUAL RELAY WALL SWITCH VACANCY SENSORS

- A. Type PW: Manual On, Automatic Off wall switch type passive infrared occupancy sensor with built-in Override Control (Off-Auto). Furnish the Company's model which suits the electrical system parameters, and accommodates the square footage coverage and wattage requirement for each area (and type of lighting) controlled; Wattstopper PW-100, PW-200.
- B. Type UW: Manual On, Automatic Off wall switch type ultrasonic occupancy sensor with built-in Override Control (Off-Auto). Furnish the Company's model which suits the electrical system parameters, and accommodates the square footage coverage and wattage requirement for each area (and type of lighting) controlled; Wattstopper UW-100, UW-200.

- C. Type DW: Manual On, Automatic Off wall-switch type, dual technology, passive infrared and ultrasonic occupancy sensor with built-in Override Control (Off-Auto). Furnish the Company's model which suits the electrical system parameters, and accommodates the square footage coverage and wattage requirement for each area (and type of lighting) controlled; Wattstopper DW-100, DW-200.

2.3 DIGITAL WALL- OR CEILING-MOUNTED OCCUPANCY SENSOR SYSTEM

- A. Wall- or ceiling-mounted (to suit installation) passive infrared, ultrasonic, or dual-technology digital (passive infrared and ultrasonic) occupancy sensor. Furnish the Company's system which accommodates the square footage coverage requirements for each area controlled, utilizing room controller modules and accessories which suits the lighting and electrical system parameters.
- B. Digital occupancy sensors shall provide graphic LCD display for digital calibration and electronic documentation. Features include the following:
 - 1. Digital calibration and LCD entry for the following variables:
 - a. Sensitivity: 0–100% in 10% increments.
 - b. Time Delay: Fixed (1–30 minutes in 1 minute increments), and Automatic.
 - c. Test Mode: 5-second time delay.
 - d. PIR, ultrasonic, or dual technology activation and/or reactivation.
 - e. Walk-Through Mode.
 - f. Load parameters, including Auto/Manual On, Blink Warning, and Daylight Enable/Disable.
 - 2. RJ-45 digital connections for DLM local network.
 - 3. Two-way infrared communications port to allow remote programming through handheld commissioning tool.
 - 4. Self-contained pushbuttons for programming and control of room devices.
 - 5. Device status LEDs, including:
 - a. PIR detection.
 - b. Ultrasonic detection.
 - c. Configuration Mode.
 - d. Load binding.
 - 6. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.
- C. Units will provide for digital calibration and commissioning and will not have any DIP switches or potentiometers for field settings.
- D. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.
- E. Wattstopper Product Numbers: LMPX, LMDX, LMPC, LMUC, LMDC.

2.4 DIGITAL WALL SWITCHES

- A. Low-voltage (RJ-45 ports) momentary pushbutton switches in 1-, 2-, 3-, 4- and 8-button configuration, decorator opening. Wall switches will include the following features:
 - 1. Two-way infrared communications port for use with personal and configuration remote controls.

2. Engraveable buttons.
3. Dimming switches shall include seven LEDs to indicate load levels.
4. Scene switches shall include pilot indication of scene selection.
5. Device status LEDs including:
 - a. One pilot LED for each button.
 - b. Power indication.
 - c. One locator LED per switch.
 - d. Network status LED to indicate data transmission.
 - e. Power LED to indicate the device has power.
 - f. Configuration Mode.

- B. Switches shall have two RJ-45 ports to allow connection to any other digital room device.
- C. Multiple digital wall switches may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required to achieve multi-way switching.
- D. Wattstopper Products Numbers: LMSW-101, LMSW-102, LMSW-103, LMSW-104, LMSW-108.

2.5 ROOM CONTROLLERS

- A. Room controllers automatically bind the room loads to the connected devices in the space without any tools or configuration requirements. Room controllers shall be provided to match the room lighting load and control requirements and sequences. The controllers will be simple to install and will have screw-type connections, DIP switches, potentiometers, or require special mounting or configuration. The control units will include the following features:
 1. Automatic room configuration to the most energy efficient sequence of operation based upon the devices in the room.
 2. One- or two-relay configuration.
 3. Simple Replacement: Using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf unit without requiring any configuration or setup.
 4. Device status LEDs to indicate:
 - a. Data transmission.
 - b. Device has power.
 - c. Status for each load.
 - d. Configuration status.
 5. Quick installation features, including:
 - a. Standard junction box mounting (inside or outside).
 - b. Quick low-voltage connections using standard RJ-45 patch cable.
 6. Plenum rated.
 7. Manual Override and LED indication of each load.
 8. Universal voltage (120/230 watts, 277 VAC, 50–60 Hz).
 9. Zero cross circuitry for each load.
 10. Efficient 150-mA switching power supply.
 11. Three RJ-45 DLM local network ports.
 12. Wattstopper Product Numbers: LMRC-101, LMRC-102.

- B. 0 to 10-volt enhanced room controllers shall include all the features of the room controller plus the following enhancements:
1. One-, two-, or three-relay configuration.
 2. Efficient 250-mA switching power supply.
 3. Four RJ-45 DLM local network ports.
 4. One 0 to 10-volt analog output per relay for control of dimmable ballasts.
 5. Optional BACnet® MS/TP communications port.
 6. Current monitoring.
 7. Wattstopper Product Numbers: LMRC-301, LMRC-302, LMRC-303.
- C. Plug load room controllers provide dedicated control of plug loads within the space. The controllers plug into the DLM local network using the RJ-45 free topology network. The room controllers include the following features:
1. One-relay configuration only.
 2. Automatic On/Off configuration.
 3. Default 30-minute (adjustable) time delay from lighting shutoff to allow for electronic component use after an area is vacant.
 4. Wattstopper Product Number: LMPL-101.

2.6 DIGITAL PHOTSENSORS

- A. Provide automatic daylight harvesting capabilities to the room controllers. The photosensor/room controller configuration automatically configures the daylighting setpoints for on/off or dimmer control. Using automatic configuration, replacing a photosensor or room controller can be done without any special tools, programming, or configuration. Photosensors include the following features:
1. The digital photosensor shall utilize an internal photodiode that measures light in a 100-degree angle cutting the unwanted light from bright sources outside of this cone.
 2. The digital photosensor shall be capable of turning lighting on and off or raise/lower depending on the bonding to the room controller. Sensor range shall be from 1–1,400 fc.
 3. For on/off daylight harvesting, the controller provides a “Hold On While Occupied” feature that prohibits high levels from turning off the controlled lights as long as the space remains occupied.
 4. The sensor has a threaded nipple that mounts on a ceiling tile and for more challenging applications such as a side wall or hard rock ceiling the nipple pops off and the unit can be screwed down.
- B. Wattstopper Product Numbers: LMLS-105, LMLS-305.

2.7 ROOM NETWORK

- A. The DLM local network is a free topology lighting control network and protocol designed to control a small area of a building. Digital room devices connect to the network using RJ-45 patch cords which provide both data and power to room devices. Features of the DLM local network include:
1. Automatic configuration and binding of sensors, switches, and lighting loads to the most energy efficient sequence of operation based upon the device attached.
 2. Simple replacement of any device in the network is required with a standard off-the-shelf unit without requiring commissioning, configuration, or setup.
 3. Push & Learn configuration that can change the automatic binding process and load parameters by using only the digital devices in the room.

4. Two-way infrared communications that allow load parameters, sensor configuration, and binding operations to be configured through a handheld configuration tool up to 30 feet from any device.

2.8 EMERGENCY LIGHTING

- A. Emergency Lighting Control Unit: A UL 924 Listed device that monitors a switched circuit providing normal lighting to an area. The unit provides normal on/off control of emergency lighting along with the normal lighting. Upon normal power failure, the emergency lighting circuit will close, forcing the emergency lighting on until normal power is restored. Features include:
 1. 120–277 volts, 50/60 Hz, 20-amp ballast rating.
 2. Push-To-Test button.
 3. Auxiliary contact for test/fire alarm system.

2.9 RELAY PANELS

- A. Lighting Control Description:
 1. Lighting control panels shall be UL Listed and consist of the following:
 - a. Enclosure/Tub: NEMA 1.
 - b. Cover: Surface or flush as required, hinged, lockable, and shall restrict access to line-voltage section.
 - c. Interior: Barrier for separation of high-voltage (Class 1) and low-voltage (Class 2) wiring. It shall include intelligence boards, power supply, and control relays. Clock display and keypad shall be mounted on interior cabinet door for easy user access and programming.
- B. Features:
 1. Panel shall accept up to eight single-pole relays. Relays shall be individual latching relays with 20-amp load contacts for ballast (including HID, magnetic- or electronic-type ballasts), tungsten, and general purpose loads. Provide isolated auxiliary contacts for pilot light switching. Relays shall use quick connectors and be individually replaceable to facilitate ease of use.
 2. Where indicated, panels shall provide space within the high-voltage section of the enclosure to accommodate up to 12 multi-pole contactors. Two sections of DIN rail mounting shall be provided as standard. No field drilling or fabrication shall be required for mounting contactors or other accessories within the enclosure.
 3. The lighting control panel shall provide a stagger-up delay, Override pushbuttons, pilot light outputs, and LED status light indicators for each relay or contactor control channel.
 4. The clock shall have a backlight display, user keypad and shall provide eight channels of time or astronomical control. Preprogrammed lighting control scenarios shall include: Scheduled On/Off, Manual On/Scheduled Off, Manual On/Automatic Switch Sweep Off, Astronomic or Photocell On/Off, and Astronomic or Photocell Control with Scheduled On/Off. Time clock shall provide up to 42 holidays, automatic daylight savings adjustment, astronomic coordinates by major cities, and help screens. Program memory shall be non-volatile and clock shall retain time keeping during power outages for at least 48 hours.
 5. The panel shall have eight universal switch inputs that are low-voltage, self-configuring and shall not require programming to accept Momentary On/Momentary Off switch, pushbutton switch (cycling), maintained switch or 24 VDC signals from occupancy sensors, photocells, or other interfacing devices.

6. Occupancy sensor and time control shall be integrated to allow occupancy sensor control after hours with Hold On of lighting during occupancy scheduled time. During occupied time, control scenarios shall be selectable for time schedule of Lighting On or occupancy sensor detection of Lighting On initially and then Hold On of lighting during occupied hours. Control shall provide selectable occupancy sensor Blink Warning prior to shutoff and adjustable occupancy sensor time delay from the time clock keypad.
7. After-hour interior lighting shutoff control shall provide a full duration override time of 1–240 minutes with a Blink Warning 5 minutes prior to shutting the lighting off. An impending shutoff will be cancelled and the override period re-initialized through the operation of any assigned switch input.
8. After-hour interior lighting shutoff control may be by line-voltage power interrupt control to automatic control switches. The lighting control relay panel shall provide a Blink Warning signal to automatic control switches, thus allowing a 5-minute delay prior to shutting off lighting. The lighting shutoff event may be cancelled by pressing the automatic control switch pushbutton. The lighting control panel time clock shall provide periodic lighting sweep signals to shut off automatic control switches.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. When using wire other than RJ-45 connections, provide detailed point-to-point wiring diagrams for every termination. Provide wire specifications and wire colors to simplify contactor termination requirements.
- B. Install the work of this section in accordance with manufacturer's printed instructions unless otherwise indicated.
- C. Calibrate all sensor time delays and sensitivity to guarantee proper coverage of occupants and energy savings.
 1. Adjust time delay so that controlled area remains lighted for 5 minutes after occupant leaves the area.
- D. Provide written or computer-generated documentation on the commissioning of the system, including room-by-room description including:
 1. Sensor parameters, time delays, sensitivities, daylighting setpoints.
 2. Sequence of operations, Manual On, Auto Off, etc.
 3. Load Parameters: Blink Warning, etc.
- E. Re-Commissioning: After 30 days from occupancy, recalibrate all sensor time delays and sensitivities to meet the Owner's project requirements. Provide a detailed report to the Architect/Owner of re-commissioning activity.

3.2 FACTORY COMMISSIONING

- A. Upon completion of the installation, the system shall be commissioned by the manufacturer's factory-authorized representative who will verify a complete fully functional system.
- B. The Electrical Contractor shall provide both the manufacturer and the Electrical Engineer with 10 working days' written notice of the system startup and adjustment date.

- C. Upon completion of the system commissioning, the factory-authorized technician shall provide the proper training to the Owner's personnel on the adjustment and maintenance of the system.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install all wiring devices as shown on the drawings and as herein specified.

1.2 ACTION SUBMITTALS

- A. Product Data: Provide manufacturer's product information for each item, including but not limited to voltage and ampere ratings, materials, finishes, and related accessories.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Switches, Receptacles, and Device Plates: Basis of design is Hubbell. Product reference numbers contained herein are for standard products offered by Hubbell. Subject to compliance with requirements, equivalent products from manufacturers listed below are acceptable.

1. Eaton/Arrow-Hart Wiring Devices.
2. Legrand/Pass & Seymour.
3. Leviton.

- B. Wall Box Dimmers: Basis of design is Lutron Electronics Co., Inc., Maestro Series. Product reference numbers contained herein are for standard products offered by Lutron. Subject to compliance with requirements, equivalent products from manufacturers listed below are acceptable.

1. Hubbell Control Solutions #RS Series.
2. Leviton #Decora Digital Series.
3. nLight #nPODM Series.
4. Sensor Switch #sPODM Series.
5. Wattstopper #Radiant Series.

- C. Miscellaneous Devices: Manufacturers are noted in the product descriptions.

2.2 SWITCHES

- A. All LINE-VOLTAGE switches shall be of the quiet mechanical type, specification grade, 20 amps, 120/277 VAC as follows:

Device	Model No.
Single Pole	1221
Two Pole	1222
Three-Way	1223
Four-Way	1224

Device	Model No.
Pilot Light	1221PL 120V 1221PL7 277V
Single Pole – weatherproof neoprene cover	HBL1750
Single Pole – weatherproof neoprene cover with pilot light	HBL1785

- B. All LOW-VOLTAGE switches shall be of the quiet mechanical type, specification grade, 3-position, 2-circuit momentary contact, center off, 15 amps, 120/277 VAC as follows:

Device	Model No.
Toggle Type – Center Position	HBL1556

- C. Switch color shall be selected by the Architect.
- D. All LINE-VOLTAGE switches shall have the ON and OFF positions indicated on the handle.
- E. If switches of higher ampere ratings are required, they shall be of similar type and quality to those shown above.

2.3 WALL BOX DIMMERS

- A. Incandescent dimmers shall be slide-to-off control. Provide wattage rating based on load to be controlled at 125%.
- B. Magnetic low-voltage dimmers shall be slide-to-off control. Dimmer shall be rated for use with magnetic transformers. Provide wattage rating based on load to be controlled at 125%.
- C. Electronic low-voltage dimmers shall be slide-to-off control. Dimmer shall be rated for use with electronic transformers. Provide wattage rating based on load to be controlled at 125%.
- D. Fluorescent 3-wire dimmers shall be slide-to-off control. Wattage ratings shall be sized for the load to be controlled. Dimmer shall be listed for use with ballast provided. Provide matching 3-way or 4-way switch(es) as appropriate.
- E. Fluorescent 2-wire (Tu-Wire) dimmers shall be slide-to-off control. Wattage ratings shall be sized for the load to be controlled. Dimmer shall be listed for use with ballast provided.
- F. 0–10 volt low-voltage dimmers shall be slide-to-off control. Dimmer shall be rated for use with fluorescent dimming ballasts or LED drivers. Provide wattage rating based on load to be controlled at 125%. Provide matching 3-way or 4-way switch(es) as appropriate.
- G. Coordinate all fluorescent, LED, and low-voltage dimmers with the controlled load voltage and lighting fixture component interface requirements.
- H. All requirements of “switches” apply.

2.4 RECEPTACLES

- A. All convenience receptacles and special outlets throughout shall be grounding type.

Device	Model No.	Location
Single	HBL5361	Non-Patient Care Areas
Single	HBL8310	Patient Care Areas
Duplex	HBL5362	Non-Patient Care Areas
Duplex	HBL8300	Patient Care Areas
Controlled – 50%	BR20C1	Non-Patient Care Areas
Controlled – 100%	BR20C2	Non-Patient Care Areas
Clock Outlet	HBL5235	
Isolated Power	IG5362	Non-Patient Care Areas
Isolated Power	IG8300	Patient Care Areas
Weather Resistant	HBL5362WR	
Tamper Resistant	BR20_TR	Non-Patient Care Areas
Tamper Resistant	8300_TR	Patient Care Areas
Ground Fault Circuit Interrupters	GFRST20	Non-Patient Care Areas
Ground Fault Circuit Interrupters	GFRST83	Patient Care Areas
Tamper Resistant & GFCI	GFTRST20	Non-Patient Care Areas
Tamper Resistant & GFCI	GFTWRST83	Patient Care Areas
Surge Protected Receptacle	HBL8362_SA	
Surge Protected & IG Receptacle	IG8362_SA	
USB Charging Duplex	USB20X2 Series	Non-Patient Care Areas
USB Charging Duplex	USB8300 Series	Patient Care Areas
USB Charging Only	USB4	

- B. Receptacles shall be specification grade, back- or side-wired, parallel slot, 2-pole, 3-wire, 20 amps as follows:

Device	Model No.
Single	5361
Duplex	5362
Controlled – 50%	BR20C1
Controlled – 100%	BR20C2
Clock Outlet	HBL5235
Isolated Power	IG5362
Weather Resistant	BR20_WR
Tamper Resistant	5362TR
Ground Fault Circuit Interrupters	GFST20
Tamper Resistant & GFCI	GFTRST20
Surge Protected Receptacle	HBL5362_SA
Surge Protected & IG Receptacle	IG5362_SA
USB Charging Duplex	USB20X2
USB Charging Only	USB4

- C. If receptacles of higher ampere ratings are required, they shall be of similar type and quality to those shown above.

- D. USB charging receptacles shall provide 5 VDC, 3.0 minimum total charging current. Regulated output shall be compatible with USB 1.0/2.0/3.0 device including Apple products. USB ports shall include standard and USB-C types and be rated for a minimum of 10,000 insertions and removals.
- E. Receptacles on emergency power shall be red; receptacles on normal power shall be selected by the Architect. Nylon plates shall match.
- F. Special receptacles shall be as noted on the drawings. Furnish caps for all special outlets.

2.5 MISCELLANEOUS CONTROLS

- A. Spring-Wound Timers:
 - 1. Spring-wound time switch shall be quiet mechanical type, specification grade, 20 amps at 125 VAC, 1 HP at 120 VAC, 2 HP at 250 VAC, 10 amps at 277 VAC, 1-hour duration (unless noted otherwise on the drawings), without hold feature. Intermatic FF Series or as accepted.
 - 2. Where noted as weatherproof (WP), provide "weatherproof while in use" cover consisting of cast aluminum material, NEMA 3R rated. Intermatic #WP1010MC or as accepted.
 - 3. All requirements of "switches" apply.
- B. Digital Timers: Digital time switch shall be wall box type, single gang, rated 120 volt, 800 watt and 277 volt, 1,200 watt. The switch shall include a Manual Switch On, Automatic function to turn lights off after a preset elapsed time, and a user temporary time override without changing the Preset Off. The Automatic Off function shall be adjustable from 5 minutes to 12 hours. Prior to extinguishing the lights, the switch shall provide a visual and audible warning to allow occupants to reset as needed. Wattstopper TS-400 Series or as accepted.
- C. Fan Controls:
 - 1. Fan controller shall provide continuous slide speed control with slide-to-off feature. Provide wattage rating based on load to be controlled at 125%. Lutron Model Nova T-star #NTFS Series.
 - 2. Additional Acceptable Manufacturers: Wattstopper Model ADFC Series or as accepted by the Architect.

2.6 DEVICE PLATES

- A. Provide wall plates for all wiring devices and outlet boxes, including special outlets, sound, signal, and telephone outlets, etc., as required. All cover plates shall be appropriate for type of device.
- B. All plates throughout shall be specification grade nylon, color to match wiring devices, EXCEPT:
 - 1. Where devices occur in mirrored surfaces, provide mirrored cover plates.
 - 2. Where devices occur in food service and kitchen areas, provide brushed stainless-steel cover plates.
- C. Where a receptacle is noted as weatherproof (WP), provide "extra duty weatherproof while in use" cover with padlock hasp, NEMA 3R rated consisting of cast aluminum material TayMac MX Series or as accepted.
- D. Weatherproof plates for switches shall be single cover, Hubbell HBL7420.

2.7 MULTI-OUTLET ASSEMBLIES

- A. Devices within the multi-outlet assembly shall meet criteria of "Receptacles."
- B. Assemblies shall be metallic, single-compartment, listed for grounding as a raceway, and shall accept full size wiring devices. Receptacles shall be provided at 24 inches on center unless otherwise noted on the drawings. Provide all components necessary for a complete installation.
- C. The product provided shall be Walker/Wiremold G4000, G3000 Series or as accepted by the Architect.
- D. Coordinate finish color with the Architect prior to ordering.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify location and mounting height of all receptacles, wall-mounted fixtures, switches, and other equipment before roughing in. Refer to the drawings for pertinent information. Refer questionable cases to the Architect.
- B. Any receptacle mounted within 6 feet of a sink or basin shall be provided with ground fault protection for personnel.
- C. Any 125 VAC, 15- or 20-amp rated device located in a kitchen shall be provided with ground fault protection for personnel.
- D. Each receptacle protected by an upstream ground fault circuit protection device shall include a label stating "GFCI Protected" on the trim face.
- E. Devices shall be mounted parallel and perpendicular to building lines.
- F. For a more attractive installation, all devices at the same location shall be ganged. Separate boxes shall not be acceptable.
- G. Low-voltage control wiring routed above ceilings without conduit shall be tied off to lighting fixture support wires. In open ceiling areas, support from appropriate hooks or rings. Excess wire shall be neatly coiled without kinks or sharp bends.

3.2 MOUNTING HEIGHTS

- A. Switches shall be installed at heights matching the architectural elevations. In no case shall switches be mounted higher than 44 inches above finish floor (AFF) to the top of box (or gang outlet ring).
- B. Receptacles shall be installed at heights matching the architectural elevations. In no case shall receptacles be mounted lower than 15 inches to bottom of box (or gang outlet ring) above finish floor (AFF) to the bottom of the lowest plug point or where intended for ADA access, more than 44 inches AFF to the top of box (or gang outlet ring). Receptacles noted at higher mountings shall only be for a specific purpose, not general use.
- C. Groups of switches shown at one location shall be installed under a single plate having the proper number of openings, and appropriate to the location.

- D. Multi-outlet assemblies shall be treated the same as receptacles relative to mounting heights. Other mountings may be delineated on plan drawings or elevations.
- E. The Contractor shall review the Architect's elevations and details to confirm device placement prior to rough-in. Submit questionable mountings to the Architect for direction.

3.3 WEATHERPROOF DEVICES

- A. Devices shall be positioned according to the cover manufacturer's listing instructions, e.g., horizontal versus vertical mounting.

3.4 WALL BOX DIMMERS

- A. Adjust dimmer faceplate spacing to accommodate full dimmer wattage. Do not remove heat sink fins/rails.
- B. Coordinate dimmer wattage with circuit load to be controlled prior to ordering. Consider fixtures at maximum lamp wattage per NEC 210.21 and 220.14(D).
- C. Install equipment in accordance with manufacturer's recommended application wiring and installation instructions.
- D. Label each dimmer, indicating which load or zone it controls.

3.5 CONTROLLED RECEPTACLES

- A. Where code required, controlled duplex receptacles shall be installed with 50% or 100% automatic occupancy control. Unless specifically indicated on the drawings, all duplex receptacles within each space required to have controlled receptacles shall be the 50% controlled type.
- B. Provide all required components to facilitate the operation of controlled receptacles to "ON" when a space is occupied. This may require occupancy sensor, power pack/relay, a wireless signal pack, and a wireless receiver receptacle for individual or multiple receptacle control if applicable.
- C. Each controlled receptacle shall have the universal receptacle control symbol indicated for 50% or 100% operation as denoted per NEC 406.3(E).

END OF SECTION

Edition: 2005-2203

SECTION 26 28 13
OVERCURRENT PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install fuses and circuit breakers as specified herein and as indicated on the drawings.
- B. Related Requirements:
 - 1. Specification Section 26 28 16, Enclosed Switches & Circuit Breakers.

1.2 ACTION SUBMITTALS

- A. Submit with specific equipment submittal:
 - 1. Short circuit interrupting data, trip unit type, power monitoring, and other features provided for each different type of overcurrent device.
 - 2. Fuse short circuit interrupting data and melt time curve.
 - 3. Include UL series combination rating data, where applicable.
 - 4. Selective coordination documentation literature for each combination to be utilized.
 - 5. Clearly indicate each rating and/or combination being utilized.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of design fuses 0 to 600V are manufactured by Bussmann. Subject to performance as compared to the basis of design fuse, the following manufacturers are acceptable:
 - 1. Littelfuse.
 - 2. Mersen.
- B. Circuit breakers shall be manufactured by the same manufacturer as the equipment within which they are installed.

2.2 MATERIALS

- A. General: Provide termination lug quantities to accommodate conductor sizes and quantities shown on the drawings. Increase circuit breaker frame sizes as required.
- B. Fuses 0 to 600V:
 - 1. Fuses 601 amperes and larger shall be UL Class L, current-limiting, time-delay, 600-volt, with interrupting rating of 200,000 amperes RMS symmetrical (Bussmann KRP-C).
 - 2. Fuses 600 amperes and smaller shall be UL Class RK1, current-limiting, time-delay, rejection-type, 600-volt or 250-volt, with interrupting rating of 200,000 amperes RMS symmetrical (Bussmann LPS-RK or LPN-RK). Ampere ratings as noted on the plans.

3. Coordination panelboard fuses shall be as follows:
 - a. Branch: UL Class CF, finger safe cube type, current limiting, and status indicating (Bussmann TCF).
 - b. Main: UL Class J.
4. Fuses shall be applied considering upstream devices, in accordance with their UL series combination ratings. All applications of fuses shall be on a single fuse per phase leg basis.
5. Furnish and deliver spare fuses to the Owner as follows:
 - a. Three spares for each type and size, in excess of 60 amperes, used for initial fusing.
 - b. 10% or a minimum of three spares for each type and size, up to and including 60 amperes, used for initial fusing.

C. Circuit Breakers, Molded-Case (UL 489):

1. Circuit breaker types shall be as graphically depicted on the one-line drawings and in accompanying notes. Types shall be molded-case solid-state, and molded-case thermal-magnetic.
2. Thermal-magnetic circuit breakers shall be trip-free, quick-make, quick-break, with handles clearly indicating rating and position (ON, OFF or TRIPPED).
3. Solid-state (SS) circuit breakers shall be equipped with a true RMS sensing, solid-state tripping system consisting of at least three current sensors, microprocessor-based trip device, and trip actuator. The trip unit shall use microprocessor-based technology to provide the basic adjustable time-current protection. The unit shall be trip-free, quick-make, quick-break, with handles clearly indicating rating and position (ON, OFF or TRIPPED).
4. Insulated case circuit breakers shall have a solid-state trip unit, and be trip-free, quick-make, quick-break, with stored energy reset handle and contact position indicator flags (ON, OFF or TRIPPED).
5. Trip Units: Trip unit functions are specified with graphical depictions and notes on the one-line drawings.
6. Where series combinations are noted to be applied on the plans, UL series combination ratings shall be maintained with upstream overcurrent device(s).
7. For distribution panels, lighting and appliance panels, or for individual mounting, circuit breakers shall have an interrupting rating no less than the available duty at the breaker. The following minimum duties shall apply where not otherwise specified:

<u>RMS-Symmetrical</u>		
<u>100A Frame</u>		
15A to 100A	14,000A @ 277V	10,000A @ 120/240V
<u>225A Frame</u>		
70A to 225A	22,000A @ 480V	25,000A @ 240V
<u>400A Frame</u>		
250A to 400A	30,000A @ 480V	42,000A @ 240V

8. Circuit breakers in 120/208V branch circuit panels shall have an interrupting rating of 10,000A RMS symmetrical, unless noted otherwise.

- D. Circuit breakers shall be UL listed for application at 100% of their continuous ampere rating in their intended enclosure where specifically indicated on the plans.

E. Ground Fault Protection:

1. Furnish and install UL listed ground sensor relay system with ground break components for each of the protective devices indicated on the drawings. Each unit shall consist of a coordinated ground sensor with integral test winding, solid-state relay to operate the shunt trip circuit on the circuit protective device, and monitor/test panel. System shall be zero sequence type.
2. Where the overcurrent protection device for which ground fault has been specified includes integral current transformers necessary for phase overcurrent protection, the ground fault functionality may be provided by vector summation of the load current in the phase conductors and neutral conductor(s) ("differential current" or "residual current" method). In such instances, provide a neutral current transformer and associated wiring back to the ground fault relay.
3. The relays shall be of the standard time-delay type and have continuously adjustable current pickup settings of 100 to 1,200 amperes and continuously adjustable time-delay setting from instantaneous (0.03 second) to 1 second. The monitor panel shall indicate relay operation and provide means for testing the system with or without interruption of service, and must not permit the ground fault system to be inadvertently left in an inactive or OFF state.
4. Where noted on the one-lines, provide modified differential type (87B, 87G, etc.), arranged as described and depicted. Provide associated CTs to fully enclose the zone protected. CTs must coordinate with the 87B and 87G relay supplied.

- F. Provide arc energy-reducing maintenance switch with local status indicator for each breaker rated 1,200 amps or higher.

2.3 ACCESSORIES

- A. Provide shunt trips, bell alarms, and auxiliary contacts as shown or noted on the contract drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fuses:

1. Install fuses in such a manner as to expose manufacturer's label indicating model number and ratings.
2. Legibly write the design fuse type on the inside of the switch cover with an indelible ink marker.
3. Coordinate installation location of the spare fuse cabinet with the Owner, and install prior to Project Closeout.
4. Fuses shall be provided in accordance with the Power System Study.

- B. Circuit Breakers: Set adjustable circuit breakers in accordance with the Power System Study.

- C. Ground Fault Protection: Set trip unit in accordance with the Power System Study.

3.2 OVERCURRENT SIZE VERIFICATION

- A. Confirm maximum overcurrent protective device (MOCP) ratings with mechanical accepted shop drawings for equipment supplied PRIOR TO ORDERING. The Contractor shall adjust the supply circuit breaker and/or fuse ratings to match accepted shop drawing MOCP data per NEC 430, 440, and 695.
- B. Where equipment includes an adjustable speed drive, upstream overcurrent device and feeder size shall be adjusted to match the rated input current to the accepted drive furnished. In no case shall the overcurrent setting be less than 125% of the nameplate load. Refer to the NEC and Division 23 specifications for requirements. Confirm accepted adjustable speed drives to be supplied PRIOR TO ORDERING related overcurrent device(s) and installing underground conduit.
- C. Prior to project completion, the Contractor shall verify that MOCP ratings match nameplate data for installed equipment. Correct MOCP device sizes as required by NEC 430, 440, and 695.

3.3 TESTING

- A. Switchboard and Circuit Breaker Testing: See Specification Section 26 05 00, General Provisions, Testing article.
- B. Test functionality of arc energy-reducing maintenance switch in accordance with the manufacturer's published literature. Verify that local status indicator is functional.

END OF SECTION

Edition: L-2007

SECTION 26 28 16

ENCLOSED SWITCHES & CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install enclosed "safety" switches and enclosed circuit breakers as shown on the drawings and as required by the NEC.

1.2 RELATED SECTIONS

- A. Specification Section 26 05 53, Identification for Electrical Systems.
- B. Specification Section 26 28 13, Overcurrent Protection.

1.3 ACTION SUBMITTALS

- A. Submit product data indicating compliance with this specification for each type of enclosed switch and circuit breaker.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Basis of Design: Drawings are based on Square D. Subject to compliance with requirements, provide the basis of design product or comparable product acceptable to the Architect by the following:
 - 1. ABB/General Electric.
 - 2. Eaton.
 - 3. Siemens.
 - 4. Square D.
- B. Switches and circuit breakers shall be mounted in a sheet metal enclosure with externally operable pad-lockable handles. Device mounting shall include an interlocking cover and suitable internal supporting members in the rear of the cabinet. Provide enclosure with an ANSI 61 finish, surface mount, except where shown recessed on the drawings. NEMA-1 for indoor applications, unless noted otherwise. All enclosures outside the building shall have a minimum of NEMA-3R ratings, unless noted otherwise.

2.2 SAFETY SWITCHES

- A. Safety switches shall be heavy-duty type, externally operated with interlocking cover, quick-make, quick-break, rated 240 Volts or 600 Volts, as applicable, with the number of poles and ampacity as noted. All switches for motors shall be horsepower rated. All switches outside the building shall have NEMA-3R enclosures. Safety switches shall be fused, except where noted to be non-fused (NF) on the drawings or otherwise specified. Fusible switches shall be capable of accepting Class R rejection fuses, but shall be set up for the fuse class indicated on the drawings.

- B. Disconnecting Means for Fractional Horsepower, 120-Volt, Single-Phase Motors:
 - 1. With Built-In Thermal Overload Protection: Single-pole, manual motor starter with pilot light unless noted otherwise. Starter ampere rating shall match branch circuit breaker.
 - 2. Without Built-In Thermal Overload Protection: Single-pole, manual motor starter with thermal overload protection and pilot light, unless noted otherwise. Starter ampere rating shall match branch circuit breaker. Overload elements shall be sized per motor manufacturer's recommendations and NEC Article 430.32. Maximum ambient temperatures shall be considered when sizing overload elements.
- C. Disconnecting means for fractional horsepower motors larger than 1/2 horsepower, for integral horsepower motors, and for equipment of similar capacity shall be provided per this section.
- D. Disconnecting means for small 120-Volt equipment 12 amps or less shall be specification grade, single-pole, 15-amp toggle switch with pilot light.

2.3 ENCLOSED CIRCUIT BREAKERS

- A. Provisions of Specification Section 26 28 13, Overcurrent Protection, shall apply.
- B. Circuit Breakers: Circuit breakers shall be molded-case, trip-free, quick-make, quick-break, thermal-magnetic type, with handles clearly indicating rating and position - ON, OFF or TRIPPED. Where series combinations are noted to be applied on the plans, UL series combination ratings shall be maintained with upstream overcurrent device(s).

2.4 DISCONNECTING MEANS FOR VFDS

- A. Where a local disconnecting means for an item of equipment is remotely located on the load side of a variable frequency drive (VFD), provide that local disconnecting means with a factory-installed electrical interlock kit. The interlock kit contact shall be wired into the VFD shutdown control to prevent damage to the VFD in the event the disconnecting means is operated while equipment is under load.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install safety switches and enclosed circuit breakers at locations indicated on the drawings, using approved fastening methods, and maintaining proper working clearances per NEC 110.26 and mounting parameters per NEC 404.
- B. Where it is not possible to install safety switches and enclosed circuit breakers on a wall, structure or item of equipment, provide rigid, freestanding supports of galvanized angle or channel. Supports shall be primed and painted.
- C. Safety Switches and Enclosed Circuit Breakers Upstream of VFDS: The shutdown interlock kit shall be field adjusted to insure the interlock contact operates before disconnecting means breaks the load contacts/switch blades.
- D. Circuit Breakers: Set adjustable circuit breakers per the engineered coordination settings.
- E. Ground Fault Protection: Set trip unit per the engineered coordination settings.

3.2 EQUIPMENT SIZE VERIFICATION

- A. Confirm the rating of the disconnecting means with mechanical shop drawings for equipment supplied PRIOR TO ORDERING. The Contractor shall adjust minimum sizes provided based on nameplate data per NEC 430 and 440.

3.3 OVERCURRENT SIZE VERIFICATION

- A. Confirm maximum overcurrent protective device (MOCP) ratings with accepted mechanical shop drawings for equipment supplied PRIOR TO ORDERING. The Contractor shall adjust the supply circuit breaker and/or fuse ratings to match accepted shop drawing MOCP data per NEC 430, 440, and 695.
- B. Where equipment includes an adjustable speed drive, upstream overcurrent device and feeder size shall be adjusted to match the rated input current to the accepted drive furnished. In no case shall the overcurrent setting be less than 125% of the nameplate load. Refer to the NEC and Division 23 specifications for requirements. Confirm accepted adjustable speed drives to be supplied PRIOR TO ORDERING related overcurrent device(s) and installing underground conduit.
- C. Prior to project completion, the Contractor shall verify that MOCP ratings match nameplate data for installed equipment. Correct MOCP device sizes as required by NEC 430, 440, and 695.

END OF SECTION

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SECTION 26 51 00

INTERIOR LIGHTING FIXTURES & LAMPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install all interior lighting fixtures with lamp assemblies as specified and as shown on the drawings. Lighting fixtures shall be complete, including canopies, hangers, reflectors, diffusers, drivers, etc.

1.2 ACTION SUBMITTALS

- A. Provide a product-specific submittal for each lighting fixture type. Catalog cut sheets illustrating conformance with specifications will be acceptable for standard units. Drawings shall indicate materials, assembly, finish, and dimensions.
- B. Photometric data shall be furnished for all lighting fixtures listed on the Lighting Fixture Schedule, and shall include the following:
 - 1. Light engine output assembly type used in photometric tests.
 - 2. Fixture candela curve with perpendicular and parallel sections.
- C. LED (light-emitting diode) light engine and driver data matrix shall include the following:
 - 1. LED light engine assembly type, wattage, dimensions, light engine color temperature in Kelvin, and Color Rendition Index for each type of lighting fixture.
 - 2. Driver type, quantity per lighting fixture, wattage/amperage, voltage, switching criteria, and dimensions for each type of lighting fixture. Clearly indicate driver power factor, load (ma), and compliance to the specifications.

1.3 WARRANTY

- A. LED lamps and drivers shall have a 24-month warranty. Lamps and drivers that fail during the initial 24-month warranty period will be replaced and installed at no cost to the Owner. Lamp failure is defined to be failure of more than 10% of the LEDs within the fixture for a specific distribution (up, down, etc.).

PART 2 - PRODUCTS

2.1 GENERAL

- A. All catalog numbers are given for manufacturer's identification and do not relieve the Contractor from responsibility of full conformance to all applicable written description requirements governing material and fabrication, either in the general or specific sections. Where conflicts occur, the most expensive option shall be enforced. Where catalog numbers are indicated as modified, no modification will be required if the standard unit fully conforms to descriptive requirements in the specifications and matches the specified installation requirements.
- B. All lighting fixtures of the same type shall be of one manufacturer and of identical finish and appearance.

- C. All lighting fixtures and component parts shall bear the UL label.
- D. All lamp assemblies installed within the same lighting fixture type shall be of the same manufacturer.
- E. All drivers installed within the same lighting fixture type shall be of the same manufacturer.
- F. Where intrusion protection (IP) ratings are specified, provide documentation indicating compliance.
- G. Clearly indicate any deviations to dimensions of specified lighting fixture.

2.2 CONSTRUCTION

- A. All steel parts shall be phosphate treated in multi-stage power spray system for corrosion resistance and paint adhesion. Standard final finish shall be electrostatically applied, baked white enamel of not less than 87% reflectance on reflecting surfaces. Refer to the Lighting Fixture Schedule and/or the drawings for other finish types.
- B. Each recessed/flush-mounted lighting fixture shall have a continuous light-seal gasket seated in such a manner as to prevent any light leakage through any portion or around any edge of the trim frame.
- C. Lenses/diffusers shall be framed in a hinged continuous assembly. Lens/diffuser frame latches shall be loaded or cam operated. Where noted on the drawings, provide tamper-resistant latches.
- D. All lighting fixture sockets shall be securely fastened to the lighting fixture body to prevent movement during relamping.
- E. For recessed lighting fixtures, provide a through-wiring junction box set to the side, where it shall be accessible when the lighting fixture reflector assembly is removed from the lighting fixture housing. Connect the box to the lighting fixture housing with flexible conduit. Clearly indicate when a lighting fixture requires above-soffit/ceiling access.
- F. All recessed lighting fixtures shall be provided with frames appropriate for the type of soffit/ceiling involved. No lighting fixtures shall be submitted for review or ordered until the soffit/ceiling construction and mounting method have been verified by the Contractor.
- G. The finish of all lighting fixtures is subject to final approval by the Architect and Engineer. Furnish paint chips to the Architect and Engineer for selection for all non-standard finishes. Color selection shall be reviewed by the Architect prior to the review of submittals by the Engineer.
- H. All electrical requirements for lighting fixtures shall be verified with the drawings, catalog number, and Lighting Fixture Schedule prior to ordering.
- I. The Contractor shall provide dimming and switching as indicated on the plans. The driver quantities shall be determined by the required switching criteria.
- J. Fixture manufacturer will test and ensure compatibility of the system components including, but not limited to, light source (engine), luminaire, driver power supply, and control interface with added components as needed for a complete and functioning system.

2.3 DRIVERS

- A. LED drivers shall be high power factor electronic type, NEMA 410 compliant. An audible noise rating of Class A shall be maintained. Driver and lamp combination shall match for optimum operational efficiency. Provide reverse polarity protection, open circuit protection requiring no minimum load. Provide 80% minimum efficiency. Manufactured by Advance, CREE, Osram Sylvania, Philips, or as accepted.
- B. Provide LED Dimming: Provide system capable of full range continuous dimming, 0 to 10-volt control.
- C. Drivers shall be CBM certified, bear the UL label, and have a sound rating of "A."
- D. Driver shall be modular in design, readily available as a replacement component, designed to be removable and replaceable from within a fixture. Driver shall not be integral to the light engine circuit board.
- E. Lighting fixtures located within low temperature, damp, and wet environments shall have drivers designed for proper operation.
- F. The Contractor shall be responsible for the replacement of drivers due to excessive noise or failure within the project warranty period.

2.4 LENSES/DIFFUSERS/LOUVERS/REFLECTORS

- A. Lenses/diffusers shall be furnished as indicated on the drawings.
- B. Lenses/diffusers shall be 100% virgin acrylic with a minimum thickness of 1/8 inch (0.125 inch), Pattern A19, unless noted otherwise on the drawings.
- C. No lens/diffuser shall be manufactured with polystyrene, copolymer (mixture of polystyrene and acrylic), or reclaimed or recycled acrylic plastic.
- D. All parabolic louvers and open reflectors shall be shipped with a protective plastic covering or coating. The protective covering shall not be removed until all construction is complete and final lighting fixture assembly is complete. The Contractor shall be responsible for cleaning all louver assemblies; in particular, removing all smudges, fingerprints, dust particles, etc.
- E. All reflector or louver striations deemed unacceptable by the Engineer shall be replaced prior to project closeout.
- F. Align lenses/diffusers/louvers/reflectors for all lighting fixtures in a like manner, unless noted otherwise.
- G. Clean luminaire reflector systems, lenses, and enclosures after all construction dust has been removed from the area.

2.5 SUPPORT

- A. Surface- or pendant-mounted lighting fixtures shall be supported as follows:
 - 1. From the outlet box by means of a metal strap, where its weight is less than 5 pounds.
 - 2. From its outlet box by means of a hickey or other threaded connection, where its weight is from 5 to 50 pounds.

- B. Lighting fixtures shall be supported independently of the ceiling system or additional ceiling suspension must be added to support the weight of the lighting fixtures. It is the responsibility of the Electrical Contractor to coordinate all support requirements with the ceiling system installer. Recessed lighting fixtures supported from ceiling grid tee systems shall be furnished with hold-down clips in conformance with NEC 410.36.
- C. Furnish and install supplementary blocking and support as required to support lighting fixtures from structural members. This blocking may include multiple members and shall be coordinated with the Structural Engineer prior to rough-in.
- D. Suspended lighting fixtures shall be stem mounted and shall be free to swing 20 degrees in any direction. Ceiling swivels shall be of the ball-aligner type.
- E. Chain suspension may be used only where specifically permitted on the drawings. Chain shall be heavy-duty, nickel- or cadmium-plated, suitable for weight of specific lighting fixture. Lighting fixtures installed in rows, continuous or spaced apart, shall be attached to a unistrut-type backbone. This backbone shall align all lighting fixtures true, straight, and level. Where chain suspension is not allowed, provide 1/4-inch-diameter, all-thread nickel- or cadmium-plated rod.
- F. All supports, where not concealed, shall be painted. Coordinate paint requirements with the Architect.

2.6 LAMPS

- A. LED Light Engines:
 - 1. LED light engines shall provide illumination with CRI greater than 80.
 - 2. LED light engines shall comply with ANSI chromaticity standard for classifications of color temperature. Reference Luminaire Schedule for specified LED lamp color and color temperature. LED light engines shall be UL or ETL listed and labeled.
 - 3. LED light engines shall be luminaire tested per IESNA LM-79 and LM-80 requirements.
 - a. Lamp Life for White LEDs: 100,000+ hours with lamp failure occurring when LED produces 70% of initial rated lumens.
 - b. Lamp Life for Color LEDs: 50,000+ hours with lamp failure occurring when LED produces 50% of initial rated lumens.
 - 4. LED Light Source Manufacturers: CREE, GE Lighting, Nichia, Osram Sylvania, Philips, or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fixtures installed in rows shall be aligned. For square trims, the flat sides shall be aligned to other fixtures in the row; or where individually mounted, aligned with the surrounding walls.
- B. Pendant fixtures shall be installed level, unless otherwise noted. Pendant fixtures occurring in rows shall be vertically and horizontally aligned.
- C. Protective films or covers shall be provided for each fixture to prevent dust and debris contamination of the fixture interior. These covers shall remain in place until substantial completion.

- D. Cleaning of reflectors shall be performed as recommended by the manufacturer. At minimum, protective gloves shall be worn to prevent body oils from contacting the reflector.

3.2 LIGHTING FIXTURE OPERATION

- A. Test for proper operation of all lighting fixtures, including control requirements for each. This may include line-voltage or low-voltage switching and/or dimming requirements.

END OF SECTION

Edition: L-2204

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SECTION 26 52 00
EMERGENCY LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish and install all interior and exterior emergency unit equipment, emergency exit signage, and emergency battery packs (EBPs) as specified and as shown on the drawings. Units shall be complete, including remote mounting, test switches, etc.

1.2 ACTION SUBMITTALS

- A. Provide a product-specific submittal for each different item. Identify use within each lighting fixture type or as a standalone unit as specified. Catalog cuts illustrating conformance with specifications will be acceptable for standard units. Drawings shall indicate materials, assembly, finish, and dimensions.
- B. Provide mounting coordination for EBP equipment installed within the specified lighting fixture prior to submitting the units for review.
- C. Illumination data shall be furnished for lighting fixtures with integral or remote-mounted EBPs, and for unit equipment per the Lighting Fixture Schedule. Data shall include the following:

1. Unit Equipment and Emergency Exit Signage:

- a. Rated voltage and wattage output at the end of the 90-minute period of operation.
- b. Battery type and temperature limitations.
- c. Listed lamp operational matrix marked with the specified lamp.
- d. Specified and supplied lamp candela curve with perpendicular and parallel sections.
- e. Overall dimensions of the complete assembly.
- f. Table of equipment for remote lamp wire size recommendations based on length.

2. Emergency Battery Packs:

- a. Fixture cut sheet indicating the rated lumen output at the end of the 90-minute period of operation.
- b. Battery type and temperature limitations.

1.3 WARRANTY

- A. LED lamps and drivers shall have a 24-month warranty. Lamps and drivers that fail during the initial 24-month warranty period will be replaced and installed at no cost to the Owner. LED lamp failure is defined as a failure of 10% of the LED chips on any one LED module (array or grouping on a single PC board).
- B. Emergency batteries shall have a 60-month warranty against battery failure.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All catalog numbers are given for manufacturer's identification and do not relieve the Contractor from responsibility of full conformance to all applicable written description requirements governing material and fabrication, either in the general or specific sections. Where conflicts occur, the most expensive option shall be enforced. Where catalog numbers are indicated as modified, no modification will be required if the standard unit fully conforms to descriptive requirements in the specifications and matches specified ceiling.
- B. Equipment shall be listed for use on emergency systems and bear the confirming UL label, UL 924.
- C. All steel parts shall be phosphate treated in multi-stage power spray system for corrosion resistance and paint adhesion. Standard final finish shall be electrostatically applied, baked enamel.
- D. Batteries shall be maintenance-free nickel-cadmium type. Battery charger shall be designed to maintain batteries at full output capacity.
- E. Fixtures located within low temperature, damp, and wet environments shall have ballasts designed for proper operation within the installed environment.
- F. The Contractor shall be responsible for the replacement of all ballasts due to excessive noise or failure for 1 year after final acceptance.

2.2 UNIT EQUIPMENT AND EMERGENCY EXIT SIGNAGE

- A. Electronics section shall include:
 - 1. Brownout protection.
 - 2. Current-limiting charger to maximize battery life and minimize energy consumption.
 - 3. Short-Circuit Protection: Current-limiting charger circuitry and fused output circuit to protect printed circuit board from shorts.
 - 4. Thermal protection to sense circuitry temperature and adjust charge current to prevent overheating and charger failure.
 - 5. Thermal compensation to adjust charger output to provide optimum charge voltage relative to ambient temperature.
 - 6. Regulated charge voltage to maintain constant-charge voltage over a wide range of line voltages and to prevent over/under charging that shortens battery life and reduces capacity.
 - 7. Filtered charger output to minimize charge voltage ripple and extend battery life.
- B. Self-diagnostic circuitry shall be provided where specified. Functionality shall include:
 - 1. Single multi-chromatic LED indicator to display charging state, test activation, and diagnostic status.
 - 2. Test switch, manual or magnetic, shall provide manual activation of 30-second diagnostic testing for on-demand visual inspection.
 - 3. Self-diagnostic testing shall occur for 5 minutes every 30 days and 30 minutes every 6 months. Diagnostic evaluation shall include lamp, AC to DC transfer, charging, and battery condition.
 - 4. Automatic test postponement for up to 8 hours by activating manual test switch.

5. Load-learning component shall self-calibrate to DC load at first test, enabling it to detect a lamp failure on future tests. Simple functionality shall be provided for recalibration at any time.

- C. Equipment housing shall include a test pushbutton and a charger failure-indicating lamp.
- D. Lamp heads shall be as scheduled. Where not indicated, provide halogen-type sealed beam.

2.3 EMERGENCY BATTERY PACKS (EBP)

- A. EBPs for LED lamps shall be provided for egress lighting fixtures when indicated on the Lighting Fixture Schedule or on the floor plans. EBPs shall illuminate LEDs to a lumen level indicated on the Lighting Fixture Schedule for 90 minutes per UL, NFPA, NEC, and OSHA Standards. All EBPs shall allow for normal switched operation with automatic switching to emergency (battery) operation upon loss of AC power. EBPs shall be installed by the fixture manufacturer. Batteries shall be NiCad or nickel metal hydride. The indication on the drawings for an "EBP" is not for night-light continuous illumination, unless otherwise specified. Pilot light and test switch shall be accessible from below fixture location and remote mount at wall where fixtures are cove mounted. Lumen output shall be provided as scheduled.

2.4 SUPPORT

- A. Surface-mounted fixtures shall be supported as follows:
 1. From the outlet box by means of a metal strap, where its weight is less than 5 pounds.
 2. From the outlet box by means of a hickey or other threaded connection, where its weight is from 5 to 50 pounds.
- B. Where remotely mounted, EBPs shall be supported independently of the ceiling system or additional ceiling suspension must be added to support the weight of the lighting fixtures. It is the responsibility of the Electrical Contractor to coordinate all support requirements with the ceiling system installer.
- C. Furnish and install supplementary blocking and support as required to support fixtures from structural members. This blocking may include multiple members and shall be coordinated with the Structural Engineer prior to rough-in.
- D. All supports, where not concealed, shall be painted. Coordinate paint requirements with the Architect.

PART 3 - EXECUTION

3.1 GENERAL

- A. Provide continuous (unswitched) power source to unit equipment and to each EBP. Do not wire fixtures containing an EBP as a default night-light, unless specified.
- B. Remote mount test switch to accessible position in wall or ceiling for remotely mounted emergency ballasts. Location shall be accessible from no more than a 6-foot ladder. Provide label as to area served.
- C. Upon completion of the project, initiate unit equipment self-diagnostic function manual test to reset memory.

3.2 BATTERIES

- A. Where emergency egress lighting fixtures are located at the exterior or in high ambient temperature environments, provide a remote battery assembly within the building interior and/or in a temperature environment suitable for the battery unit based on the equipment manufacturer recommendations to maintain the design battery life.

3.3 LIGHTING FIXTURE OPERATION

- A. Test for proper operation of unit equipment and lighting fixtures containing emergency ballasts or emergency carryover ballasts, including control requirements for each. This may include local switching, low-voltage switching, and/or dimming requirements. Verify that emergency ballasts or emergency carryover ballasts have not been wired as default night-lights, unless specified.

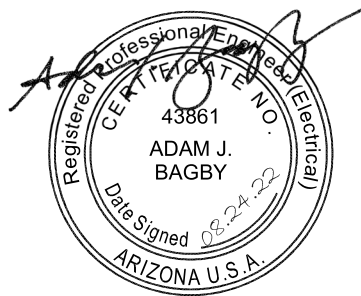
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Edition: L-1710

DIVISION 27
COMMUNICATIONS

27 05 00	Common Work Results for Communications
27 05 00	General Provisions
27 05 13	Communication Services
27 05 26	Grounding & Bonding for Communications Systems
27 05 28	Pathways for Communications Systems
27 05 44	Sleeves & Sleeve Seals for Communications Pathways & Cabling

END OF INDEX



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SECTION 27 05 00

GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SCOPE

- A. Provisions of this section apply to all work specified in all sections under Division 27.
- B. In addition, work in Division 27 is governed by the provisions of the Bidding Requirements, Contract Forms, General Conditions, and all sections under Division 01 specifications.
- C. Communications equipment coordination and installation.

1.2 QUALITY ASSURANCE

A. Reference Standards:

- 1. Design, manufacture, test, and install data distribution systems per manufacturer's requirements and in accordance with NFPA 70 (National Electric Code), state codes, local codes, requirements of authorities having jurisdiction, and particularly the following specifications.
 - a. This Technical Specification and Associated Drawings.
 - b. ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises, and its published addenda.
 - c. ANSI/TIA-568-C.1, Commercial Building Telecommunications Cabling Standard, and its published addenda.
 - d. ANSI/TIA-568-C.2, Copper Cabling Components Standard, and its published addenda.
 - e. ANSI/TIA-568-C.3, Optical Fiber Cabling Components Standard, and its published addenda.
 - f. ANSI/TIA/EIA-569-B, Commercial Building Standard for Telecommunications Pathways and Spaces, and its published addenda.
 - g. ANSI/TIA/EIA-606-A, Administration Standard for the Telecommunications Infrastructure of Commercial Buildings, and its published addenda.
 - h. ANSI/J-STD-607-A, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications, and its published addenda.
 - i. Building Industries Consulting Services International (BICSI) Telecommunications Distribution Methods Manual (TDMM).
 - j. Manufacturer's Design and Installation Contractor Agreement.
 - k. ANSI/TIA-942, Telecommunications Infrastructure Standard for Data Centers, and its published addenda.

1.3 EXAMINATION OF PREMISES

- A. Visit the site, verify all measurements and job conditions, and pay all costs necessary to perform the work.

1.4 SUMMARY

- A. Types of data/communication cable systems specified in this section include the following:
1. Fiber-optic cable systems.
 2. Voice communication cable system.
 3. Data communication cable system.
 4. CATV communication cable system.
 5. Associated conduit raceway distribution and equipment rack/cabinet system.
- B. The Contractor shall furnish, install, and test conduit system, cable and conduit support system, fire-stopping, fiber-optic, voice, data and CATV cables, associated connectors, patch panels, equipment racks, grounding system, patch cords, etc., as indicated on the drawings and in these specifications.
- C. The Contractor shall include all work shown on the drawings and in the specifications. The drawings and specifications are intended to agree with each other. Any discrepancies shall be brought to the attention of the Architect/Engineer for correction. No omission from any drawing shall release the Contractor from furnishing equipment, materials, or services required by these documents.
- D. The Contractor, the cable manufacturer, the connectivity manufacturer, and the distributor shall collaborate and work in partnership with one another so as to provide the Owner with UL or ETL independently verified cabling installation that is guaranteed to perform at levels above and beyond the EIA/TIA-568B Standards, as per the minimum acceptable full channel performance specification contained herein. The partnership shall make available optional UL or ETL independent testing and verification of the completed installation.
- E. Cable infrastructure project requires a manufacturer structured cabling system. the cabling system shall be backed by 25-year system performance guarantee/warranty. The system guarantee/warranty shall be facilitated by the Contractor and be established between the Customer and the cabling system manufacturer.
- F. Any deviation, alteration, or substitution from the drawings and specifications shall be fully documented by the Contractor and submitted as a voluntary alternate to the base bid with the amount of deduct to the base bid specified. Approval of requests for substitution of products, processes, or procedures other than those specified shall be contingent upon submission of fully acceptable documentation to the Engineer.
- G. Products that are submitted for substitution must be electrically and mechanically interchangeable with the specified product. Substitutions shall only be allowed with written approval from the Engineer. Samples of proposed substitutions must be submitted prior to approval, at the discretion of the Engineer. Any substitutions without the written approval of the Engineer are done so at the risk of the Contractor. Substitutions unacceptable to the Engineer shall be rejected without explanation or appeal.
- H. The Contractor shall also be responsible for protecting any and all equipment and materials from damage during his installation process. Any equipment, material, and/or facilities damaged by the Contractor during, due to, or in the performance of his contract, shall be replaced or repaired at the expense of the Contractor, as directed by the Engineer.

1.5 QUALITY CONTROL

- A. Manufacturer Qualifications: Firms regularly engaged in the manufacture of communication cabling system equipment whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer Qualifications:
 - 1. Installers shall be fully capable and experienced in communication cabling system specified and a certified installer by specified manufacturer. This Contractor and all subcontractors engaged in this communication cabling installation shall have experience in this business for not less than 5 years and shall have successfully completed a minimum of five projects of similar size.
 - 2. The Contractor shall specify, in his bid, all subcontractors who shall be utilized in this project. Each subcontractor's company name, contact, and responsibilities shall be listed.
 - 3. The Contractor shall employ a Registered Communication Distribution Designer (RCDD) who shall be responsible to the Engineer, Architect, and Owner for all work performed by the Contractor and his subcontractors. The RCDD shall have the authority of the Contractor to make immediate decisions regarding implementation of changes to the project as directed by the Engineer or Architect.
 - 4. The RCDD must be a full-time employee of the company.
 - 5. If, in the opinion of the Engineer, Architect, or Owner, the RCDD does not possess or demonstrate adequate qualifications to support the project, the Owner reserves the right to require the Contractor to assign an RCDD who, in the Owner's opinion, possesses the skill necessary to complete the project.
- C. On-Site Project Manager (Project Foreman):
 - 1. The Project Manager shall report directly to the RCDD, Engineer, Architect, and Owner for quality of installation and compliance with these documents.
 - 2. The Project Manager shall be a manufacturer-certified and BICSI-registered cabling installation technician, National Joint Apprenticeship & Training Committee (NJATC) installer technician, BICSI RCDD, or Engineer-approved equal and have a minimum of 2 years of experience.
 - 3. The Project Manager shall maintain all documentation in accordance with these specifications.
- D. Journeymen and apprentices performing work under this specification shall be enrolled in or have completed the BICSI, registered cabling installation technician, NJATC installer technician, or Engineer-approved equal course.

1.6 EQUIPMENT PURCHASES

- A. All materials and equipment shall be ordered in ample quantities for delivery at the proper time. If items are not on the project in time to expedite completion, the Owner may purchase said equipment and materials and deduct the cost from the Contract Sum.
- B. Provide all materials of similar class or service by one manufacturer.

1.7 DRAWINGS AND SPECIFICATIONS

- A. If a conflict exists on the drawings or between the drawings and specifications, promptly notify the Architect.

1.8 SUBMITTALS

- A. Submittals are for information and coordination only. The Engineer will diligently review the submittals and attempt to verify compliance with the project requirements. Such review, however, does not constitute approval or disapproval or obligation to comply with all project requirements. The submittals are not to be construed to be Contract Documents. Any failure by the Engineer to note a point of non-compliance shall not be construed to be acceptance or approval of the discrepancy.
- B. Product Information Sheets: Provide manufacturer's literature which includes the information required by the Product Data paragraph of the applicable specification section. Where Product Information Sheets show multiple models or options, clearly mark the model and options to be provided.
- C. Assembly: Assemble all required submittal information for each specification section and submit in PDF format.
 - 1. Assemble PDF submittals in one PDF file for each division. Separate and order sections within each file by corresponding specification number. Provide bookmarks at the first page of each section and label each bookmark with the specification number and name to allow for easy navigation of the submittal.
 - 2. Partial submittals will be returned without review.
- D. Identification and Information:
 - 1. Name the PDF file with the project name, division number, and sequential submittal number (i.e., the first submittal shall be No. 1; the second submittal shall be No. 2).
 - 2. Provide a cover sheet at the front of each submittal with the following information:
 - a. Project name.
 - b. Date.
 - c. Name of Engineer.
 - d. Name of Contractor.
 - e. Name of subcontractor.
 - 3. Provide a cover sheet at the front of each submittal section with the following information:
 - a. Name of supplier.
 - b. Name of manufacturer.
 - c. Number and title of appropriate specification section.
 - d. Drawing number and detail references, as appropriate.
 - e. Other necessary identification.
- E. Options:
 - 1. Identify options requiring selection by the Engineer.
 - 2. Identify options included with submittal item.
- F. Deviations: Identify deviations from the Contract Documents on submittals.

1.9 MATERIAL SAFETY DATA SHEETS

- A. Provide current Material Safety Data Sheets (MSDS) for all hazardous chemicals that are proposed for use at the project site.

1. Provide one complete set to the Owner for review and approval a minimum of 1 week prior to the delivery of any hazardous chemicals to the site.
2. Maintain a second complete set at the project location, readily accessible by both the Owner's personnel and the Contractor's personnel.

1.10 REQUEST FOR INFORMATION

A. Request for Information:

1. A document submitted by the Contractor requesting clarification of a portion of the Contract Documents, hereinafter referred to as RFI.
2. A properly prepared Request for Information shall include a detailed written statement of the clarification, apparent conflict, or information requested that indicates the specific drawings or specification in need of clarification and the nature of the clarification requested.
 - a. Drawings shall be identified by drawing number and location on the drawing sheet.
 - b. Specifications shall be identified by section number, page, and paragraph. Include a proposed solution, where appropriate, based upon the field conditions and best knowledge of the Contractor.

B. Improper or Frivolous RFIs: RFIs which are not properly prepared or that request information which is clearly shown in the Contract Documents will be returned unanswered. Processing time for multiple submissions of improper or frivolous RFIs will be billed at the Engineer's standard hourly rate to the Owner who may deduct an equal amount from the monies due the Contractor.

1.11 AS-BUILT DRAWINGS

A. As-Built Drawings: Maintain one set of marked-up paper copies of the Contract Drawings.

1. Preparation: Mark As-Built Drawings to show the actual installation where installation varies from that shown originally. Include all equipment, and underground and overhead conduit. 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 As-Built Drawings.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Include dimensions both horizontally and vertically to permanent points of reference, accurate within 6 inches. Include descriptors such as "below slab," "above ceiling," etc.
 - c. Record data daily or as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
2. Mark the As-Built Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of As-Built Drawings.
3. Mark the As-Built Drawings with erasable, red colored pencil, or in a digital PDF format using an editor program such as Bluebeam, Adobe Acrobat Professional, or similar. Use other colors to distinguish between changes for different categories of the work at the same location.
4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
5. Update the As-Built Drawings weekly or daily as appropriate for the project size.

- B. Format: Identify and date each As-Built Drawing; include the designation "PROJECT AS-BUILT DRAWING" in a prominent location.
 - 1. Organize newly-prepared As-Built Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 - 2. Identification, as follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT AS-BUILT DRAWINGS."
 - d. Name of Engineer.
 - e. Name of Contractor.
 - 3. Remove or obscure the Engineer's seal and signature from As-Built Drawings.

1.12 OPERATION AND MAINTENANCE MANUAL

- A. Prior to completion of the project, compile a complete equipment Operation and Maintenance Manual for all equipment supplied under Division 27.
- B. Schedule:
 - 1. Submit a preliminary copy of the manual not less than 30 days prior to substantial completion for review and comment.
 - 2. Submit the final version of the manual not more than 4 weeks after substantial completion of the project.
- C. Format: Submit manuals in both of the following formats:
 - 1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Engineer.
 - 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. Provide one final copy to the Engineer and two copies to the Owner.
 - 2. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Engineer will return three copies.
- D. Provide Operation and Maintenance Manuals for all systems, subsystems, and equipment that require operation and regular maintenance, or have replaceable parts.
- E. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, product data, manufacturer's 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. In addition to requirements in this section, include operation and maintenance data required in individual specification sections.

- F. Source Information: List each system, subsystem, and piece of equipment included in the manual, identified by product name and arranged to match the manual's table of contents. For each product, list the name, address, and telephone number of the installer or supplier and maintenance service agent, and cross-reference specification section number and title in the Project Manual.
- G. Product Data: Include the following information:
1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Approved submittals.
 3. Include the following if not shown on approved submittals:
 - a. Product name and model number. Use designations for products indicated on Contract Documents.
 - b. Manufacturer's name.
 - c. Equipment identification with serial number of each component.
 - d. Equipment function.
 - e. Operating characteristics.
 - f. Limiting conditions.
 - g. Performance curves.
 - h. Engineering data and tests.
- H. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures, including precautions against improper use.
 10. Operating logs.
- I. Wiring Diagrams: Diagram of factory-installed wiring, including any options as well as any field modifications.
- J. Systems and Equipment Controls: Describe the sequence of operation and diagram controls as installed.
- K. Manufacturer's Maintenance Documentation: Manufacturer's 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.
- L. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.

2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

- M. 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.
- N. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturer's maintenance documentation and local sources of maintenance materials and related services.
- O. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- P. Licenses: Include copies of any licenses with requirements, including inspection and renewal dates.
- Q. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1.13 WORK AND MATERIALS

- A. Unless otherwise specified, all materials must be new and of the quality specified. The workmanship shall be of a quality that is acceptable to the Architect, Engineer, and Owner, and is equal to the standards of the trades. Contractor must staff the project with sufficient skilled workmen, including a fully qualified construction superintendent, to complete the work in the time allotted. The superintendent must be qualified to supervise all of the work in his work category.
- B. Uniformity: Unless otherwise specified, provide all equipment and products of the same type or classification by the same manufacturer.

1.14 APPROVALS OF MATERIALS AND EQUIPMENT

- A. Refer to Division 01 specifications for description of material and equipment for prior approvals and substitutions.

1.15 COOPERATIVE WORK

- A. Correct without charge any work requiring alteration due to lack of proper supervision or failure to make proper provision in time. Correct without charge any damage to adjacent work caused by the alteration. Refer to Division 01 specifications for additional requirements.
- B. Cooperative Work Includes:
 1. General supervision and responsibility for proper location, rough-in, and size of work related to Division 27 but provided under other divisions of these specifications.
 2. Installation of sleeves, inserts, and anchor bolts for work under sections in Division 27.

1.16 CONSTRUCTION FACILITIES

- A. General: Under this division of the specifications, execute all work in a manner to provide safe and lawful ingress and egress to the Owner's establishment and such facilities shall be kept clear of materials or equipment. Refer to Division 01 specifications for additional requirements.
- B. Furnish and maintain from the beginning to the completion of all work all lawful and necessary guards, railings, fences, canopies, lights, and warning signs. Take all necessary precautions required by city and state laws to avoid injury or damage to any and all persons and property.

1.17 WARRANTY

- A. Manufacturer Warranty:
 - 1. Facilitate a 25-year system performance warranty between the manufacturer and the Owner. An extended component warranty shall be provided which warrants functionality of all cabling and connectivity components used in the system for 25 years from the date of acceptance. The performance warranty shall warrant the installed horizontal copper and both the horizontal and the backbone optical fiber portions of the cabling system. Copper and Fiber Optic drops shall be warranted to the link performance as defined in the ANSI/TIA-568-C Standards.
 - 2. Upon completion of the project, the Customer's technical representative will perform a final inspection of the installed cabling system with the Contractor's Project Foreman. The final inspection will be performed to validate that all horizontal and backbone cables were installed as defined in the drawing package, and that the installation meets the aesthetic expectations of the Customer.
 - 3. Upon receipt of the test documentation, the Customer reserves the right to perform spot testing of a representative sample of the cabling system to validate test results provided in the test document. Customer testing will use the same method employed by the Contractor, and minor variations will be allowed to account for differences in test equipment and test variability. If significant discrepancies are found, the Contractor will be notified for resolution.
 - 4. During the 3-week period between final inspection and delivery of the test and as-built documentation, the Customer will activate the cabling system. The Customer will validate operation of the cabling system during this period.
 - 5. Completion of the installation, in-progress and final inspections, receipt of the test, receipt of the as-built documentation, and successful performance of the system for a 2-week period will constitute acceptance of the system.
- B. Special Warranty: Warrant the cabling system against defects in workmanship for a period of 1 year from the date of system acceptance. The warranty shall cover all labor and materials necessary to correct a failed portion of the system and to demonstrate performance within the original installation specifications after repairs are accomplished. This warranty shall be provided at no additional cost to the Owner.

1.18 CONNECTIONS TO UTILITY SYSTEMS

- A. Provide connections to serving utility companies, including, but not limited to, telephone and CATV, as indicated on the plans. Contact utility companies and obtain the final design plans. Coordinate equipment, installation, and inspections with the serving utility. The Contractor shall include contact, coordination, inspections, utility company fees, and work described on the serving utility design plans as part of the work of this contract.

1.19 CONSTRUCTION FACILITIES

- A. General: Under this section of the specifications, execute all work in a manner to provide safe and lawful ingress and egress to the Owner's establishment. Construction facilities shall be kept clear of materials or equipment as directed by the Architect.
- B. From the beginning to completion, furnish and maintain all lawful and necessary guards, railings, fences, canopies, lights, warning signs, etc. Take all necessary precautions required by city and state laws and OSHA to avoid injury or damage to any persons and property.
- C. Temporary toilet facilities are specified and furnished under another section.

PART 2 - PRODUCTS

2.1 CONCRETE

- A. Where used for structures to be provided under the Contract such as bases, etc., concrete work and associated reinforcing shall be as specified under that division.
- B. Refer to other sections for additional requirements for underground vaults, cable ducts, etc.

2.2 FRAMING CHANNEL

- A. The framing channel shall be a cold-rolled, high-quality, carbon steel channel with factory-applied, hot-dipped-after-fabrication finish. Utilize factory-built interconnecting components, mounting straps, connectors, etc., designed for use with the framing channel supplied. Channel nuts shall be spring type and shall utilize standard US threads. Provide heavy zinc paint for field touchup. B-Line "B" Series, Unistrut "P" Series, or as accepted by the Architect.

2.3 ANCHORS

- A. Anchors shall be expandable lead type, as manufactured by Ackerman-Johnson, Diamond, Hilti, Pierce, or as accepted by the Architect.
- B. Adjustable concrete hanger inserts shall be as manufactured by Grinnell or as accepted by the Architect.

PART 3 - EXECUTION

3.1 SUBMITTALS

- A. Prepare submittals as directed for review by the Contractor, Owner, Architect, and Engineer.
- B. Submit one copy of PDF submittals via email, project website, or other electronic media.

3.2 AS-BUILT DRAWINGS AND RECORD DOCUMENTS

- A. Recording: Post changes and modifications to the As-Built Drawings as they occur; do not wait until the end of the project.

- B. Maintenance of As-Built Drawings and Record Documents: Store Record Documents in the field office, apart from the Contract Documents used for construction. Do not use project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project Record Documents for the Engineer's reference during normal working hours. As-Built Drawings will be reviewed by the Architect, Owner, and Engineer at each pay request review.
- C. Submit As-Built Drawings to the Architect at completion of the project.

3.3 OPERATION AND MAINTENANCE MANUALS

- A. Prepare Operation and Maintenance Manuals as directed for review by the Contractor, Owner, Architect, and Engineer.
- B. Make corrections and resubmit as required.

3.4 VERIFICATION OF DIMENSIONS

- A. Scaled and figured dimensions are approximate only. Before proceeding with work, carefully check and verify dimensions at the site, and be responsible for properly fitting equipment and materials together and to the structure in spaces provided.
- B. Drawings are diagrammatic and many offsets, bends, special fittings, and exact locations are not indicated. Carefully study drawings and premises in order to determine the best methods, exact locations, routes, and building obstructions, and install apparatus and equipment in available locations. Install apparatus and equipment in a manner and in locations to avoid obstructions, preserve headroom, and keep openings and passageways clear.

3.5 CUTTING AND PATCHING

- A. Cut work and patch per Division 01 specifications as necessary to properly install the new work. As the work progresses, coordinate necessary openings, holes, chases, etc., in their correct location. If the required openings, holes, and chases are not in their correct locations, make the necessary corrections at no cost to the Owner. Avoid excessive cutting and do not cut structural members without the consent of the Architect. Include as a part of the work all structural framing required by penetrations through the roof and necessary steel to support ducts and pipes between structural steel unless shown on the structural drawings.

3.6 CLOSING-IN OF UNFINISHED WORK

- A. Cover no work until inspected, tested, and approved. Where work is covered before inspection and test, uncover it, and when inspected, tested, and approved, restore all work to original proper condition.

3.7 EXCAVATION AND BACKFILL

- A. Perform all necessary excavation, shoring, and backfilling required for the proper laying of all raceways, ducts, and conduits inside the building and premises, and outside as may be necessary. Remove all excess excavated materials from the site or dispose of on site as directed by the General Contractor.

- B. Excavate all trenches open cut, keep trench banks as nearly vertical as practicable, and sheet and brace trenches where required for stability and safety. Excavate trenches true to line and make bottoms not less than 18 inches wide but no wider than necessary to provide ample work room. Grade trench bottoms accurately to provide uniform bearing and support for each section of pipe on undisturbed soil along its entire length. Dig "bell" holes after the trench bottom has been graded. Machine grade only to the top line of the raceways, doing the balance by hand. Do not cut any trench near or under footings without first consulting the Architect. Comply with OSHA requirements.
- C. Provide not less than 4 inches of granular material as pipe bedding prior to laying pipe in trench to continuously support pipe and maintain required slope. Granular material shall be pea gravel or sand per MAG Standards.
- D. Provide backfilling and compaction in accordance with provisions of these specifications and under the direction of the Architect to the required density.
- E. Provide not less than 4 inches of granular material, same as piping bedding, all around pipe. Make the first 2 feet of fill in 6-inch layers, each thoroughly compacted as directed, and free from rocks, large clods of earth, leaves, branches, and debris. Compact the rest of the backfill as directed, using in the backfill no rocks larger than 4 inches in diameter, and using no rock in the top 12 inches.

3.8 ACCESSIBILITY

- A. Install all control devices or other specialties requiring reading, adjustment, inspection, repairs, removal, or replacement conveniently and accessibly throughout the finished building. Where any of these devices are shown on the Contract Drawings to be installed above any inaccessible ceiling or behind any inaccessible wall, the Low-Voltage Communications Contractor shall furnish access doors or panels as required.
- B. All access doors or panels in walls and ceilings required for access to control devices, traps, valves, and similar devices are to be furnished and installed as part of the work under this section. Provide type as specified in Division 08 specifications.
- C. Refer to architectural drawings for type of wall and ceiling in each area and for rated construction.
- D. Coordinate work of various sections to locate valves, traps, and dampers with others to avoid unnecessary duplication of access doors.
- E. The Contractor, along with the Owner's representative, shall complete the Low-Voltage Communications Accessibility/Clearance Checklist at the end of this section for all communications equipment. The chart shall be submitted to the Architect for approval prior to Substantial Completion. All conflicts shall be resolved to the Architect's and Owner's satisfaction prior to submission.
- F. Provide doors that pierce a fire separation with the same fire rating as the separation.

3.9 ROOF FLASHINGS

- A. Flash and counterflash all piping, conduits, and ductwork penetrating roofing membrane with flashing per roofing manufacturer's recommendations. Refer to architectural drawings for detailing of duct and pipe penetrations through roof.

3.10 PRODUCT AND EQUIPMENT INSTALLATION – COMMON REQUIREMENTS

- A. All equipment, valves, sensors, dampers, detectors, etc., shall be installed in strict conformance with the manufacturer's recommendations and all codes.
- B. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- D. Install communications equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations.
- E. Do not install any equipment in an application not recommended by the manufacturer.

3.11 EQUIPMENT ROUGH-IN

- A. Rough-in all equipment and fixtures as designated on the drawings and in the specifications. The drawings indicate only the approximate location of rough-ins. The exact rough-in locations must be determined from large-scale certified drawings. The Contractor shall obtain all certified rough-in information before progressing with any work for rough-in final connections.
- B. Be responsible for providing all outlets and services of proper size at the required locations.
- C. Minor changes in the Contract Drawings shall be anticipated and provided for under this division.
 - 1. Rough-in only (unless otherwise designated on the drawings) shall include providing all services as indicated and required, including all conduit and conductors. Cap all conduit stub-outs in a manner suitable for future extension.

3.12 EQUIPMENT FINAL CONNECTIONS

- A. Provide all final connections for the following:
 - 1. All equipment furnished under this division.
 - 2. Communications equipment furnished under other sections of the specifications (except as otherwise designated).
 - 3. Owner-furnished equipment as shown on the drawings.

3.13 OWNER-FURNISHED AND OTHER EQUIPMENT

- A. Rough-in only for all Owner-furnished equipment (refer to Division 01 specifications) and all equipment furnished under other sections of the specifications, except as otherwise specified and/or noted on the drawings.

3.14 EQUIPMENT SUPPORTS

A. Erection of Metal Supports and Anchorages:

1. Refer to Division 05 specifications for structural steel.
2. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor communications materials and equipment. Neatly fabricate and erect steel work with burrs and welding spatter ground off. Paint after fabrication with a rust-inhibitive primer.
3. Field Welding: Comply with AWS D1.1.

B. Erection of Wood Supports and Anchorages:

1. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support and anchor communications materials and equipment.
2. 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.
3. Attach to substrates as required to support applied loads.

C. Concrete Inserts: Furnish and install all concrete inserts required for all materials and equipment specified and/or shown on the drawings for Division 27.

D. Concrete Bases: Work under this section includes coordination of construction of all concrete foundations indicated or required for equipment specified under Division 27. Materials and workmanship shall be as described in Division 03 specifications. 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 1 inch (25 mm) larger in both directions than supported unit footprint. Where servicing apparatus for draw-out circuit breakers requires a level surface in front of the switchboard or switchgear, coordinate pad front extension so as to allow service to occur using standard apparatus. Where utility meters occur, pads shall conform to the serving utility requirements.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extends 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. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

E. Grouting:

1. Grout under all equipment after leveling, filling completely the space between machinery bed plate and foundation surface as specified in Division 03 specifications.
2. Mix and install grout for communications equipment base bearing surfaces and other equipment base plates, and anchors.
3. Clean surfaces that will come into contact with grout.
4. Provide forms as required for placement of grout.
5. Avoid air entrapment during placement of grout.
6. Place grout, completely filling equipment bases.
7. Place grout on concrete bases and provide smooth bearing surface for equipment.

8. Place grout around anchors.
9. Cure placed grout.
10. Finish exposed surface of grout for a neat appearance.

3.15 CLEANUP

- A. In addition to cleanup specified in Division 01 specifications, thoroughly clean all parts of the equipment. Where exposed parts are to be painted, thoroughly clean off any splattered construction materials and remove all oil and grease spots. Wipe the surface carefully and scrape out all cracks and corners.
- B. During the progress of the work, keep the premises clean and free of debris.

3.16 PAINTING

- A. Except as otherwise specified or indicated in the architectural drawings and/or specifications, paint all exposed unfinished metal with one coat of rust-inhibiting primer. Galvanized ductwork and factory-painted equipment shall be considered as having primed surface.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- C. Finished painting is specified in Division 09 specifications.

3.17 OBJECTIONABLE NOISE AND VIBRATION

- A. Construct and brace the metal partitions, ducts, and sheet metal housings to prevent vibration or rattling when systems are in operation. Install connections to equipment so noise and vibration will not reach the conditioned area through ducts, piping, conduit, sheet metal work, or the building structure.

3.18 TESTING

- A. Upon completion of the communication work, the entire installation shall be tested and demonstrated to be operating satisfactorily. Tests and documentation shall be in accordance with EIA/TIA Acceptance Testing Specifications for Communication Equipment and Systems.
- B. Additional equipment-specific testing is described in the equipment's respective section of this division.
- C. Furnish a written report of testing to the Architect. At a minimum, the report shall include:
 1. Testing Contractor's letterhead.
 2. Testing technician's name and signature.
 3. Date and time that test was performed.
 4. Ambient temperature and weather conditions.
 5. Test equipment manufacturer, model number, and last calibration date.
 6. The manufacturer, model number, and, as applicable, trip unit model number and available adjustments of tested equipment.
 7. Statement of "As Left" conditions.
 8. Pass/Fail statement.
 9. Recommendations if any.

- D. The Contractor shall submit the Testing Schedule to the Architect 2 weeks prior to initiation of testing activity.

END OF SECTION

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SECTION 27 05 13

COMMUNICATION SERVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Communications equipment coordination and installation.
 - 2. Sleeves for pathways and cables.
 - 3. Raceway systems.
 - 4. Common communications installation requirements.
- B. Related Sections:
 - 1. Specification Section 27 05 26, Grounding & Bonding for Communications Systems.
 - 2. Specification Section 26 05 33, Raceway & Boxes for Electrical Systems.

1.3 QUALITY ASSURANCE

- A. NEC Compliance: Comply with NEC as applicable to Communication System Materials and Installation.
- B. NEMA Compliance: Comply with applicable portions of NEMA Standards pertaining to Types of Electrical Equipment Enclosures.
- C. EIA/TIA-569A Compliance: Comply with EIA/TIA-569A Standards for Telecommunication Pathways and Spaces for Commercial Buildings.

1.4 SUBMITTALS

- A. Product Data: For sleeves, seals, cable ladder, and back boxes.

1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of communications 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 pathways, 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 communications item that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 specifications.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 specifications.
- E. Conduit systems shall be color coded. Conduit shall be factory anodized in color as stated within Specification Section 26 05 53, Identification for Electrical Systems.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR COMMUNICATIONS 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: Installed to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right-of-Way: Give to piping systems installed at a required slope.

3.2 CABLE LADDER

- A. Cable ladders shall be installed per manufacturer's instructions, utilizing product series accessories and components.
- B. Cable ladders, supports, and brackets shall be cleanly cut, deburred, and sharp edges removed.
- C. Verify installed loading requirements and install the raceway system per the manufacturer's recommendations. Provide additional load capacity to support a 2X growth factor.
- D. Install end caps, mounting spacers, couplings, hangers, brackets, dropouts, connectors, supports, and other manufacturer's accessories as required to provide a complete and functioning installation.

3.3 CONDUIT

- A. Conduit shall be sized per Table 1 below, or as noted on the drawings. Where sections of conduit runs are longer than 100 feet, or have more than 180 degrees of bends, or have a reverse bend (greater than 90 degrees), pull boxes shall be provided and installed. Bends in conduit larger than 2 inches shall be long sweep type. Except where specifically noted, the inside radius of bends shall not be less than:
1. Six times the internal diameter of conduits 2 inches and smaller.
 2. Ten times the internal diameter for conduits 2-1/2 inches and larger.

TABLE 1.											
Inside Diameter in mm	Trade Size	Cable Outside Diameter in mm (inches)									
		3.3 (0.13)	4.6 (0.18)	5.6 (0.22)	6.1 (0.24)	7.4 (0.29)	7.9 (0.31)	9.4 (0.37)	13.5 (0.53)	15.8 (0.62)	17.8 (0.70)
16	1/2	1	1	0	0	0	0	0	0	0	0
21	3/4	6	5	4	3	2	2	1	0	0	0
27	1	8	8	7	6	3	3	2	1	0	0
35	1-1/4	16	14	12	10	6	4	3	1	1	1
41	1-1/2	20	18	16	15	7	6	4	2	1	1
53	2	30	26	22	20	14	12	7	4	3	2
63	2-1/2	45	40	36	30	17	14	12	6	3	3
78	3	70	60	50	40	20	20	17	7	6	6
91	3-1/2							22	12	7	6
103	4							30	14	12	7

- B. Conduits entering telephone and data closets shall terminate as close as possible to the wall through which the conduits enter, unless otherwise noted. In-floor conduit shall terminate 4 inches above finish floor (AFF) or curb unless noted otherwise. All conduits shall be left clean, dry, and free of debris or other obstructions, with insulated grounding bushings installed.
- C. Pull boxes shall be sized and installed per BICSI Standards.
- D. Conduit, sleeves, and stubs through fire rated floors and walls shall be rigid galvanized steel conduit with insulated and/or grounding bushings per specifications. Conduit sleeve shall extend a minimum of 6 inches beyond each wall surface. Upon completion of the work, install fire stop per specifications and codes.
- E. Furnish and install pipe sleeves as shown on the drawings. The sleeves shall extend 4 inches above the floor and a minimum of 2 inches below the bottom of the ceiling slab. The inner edges of the sleeve shall be reamed, providing a smooth surface to prevent damage to cable insulation. Sleeves shall be equipped with metal caps to ensure fireproofing between floors and/or insulated bushings when occupied with cable.
- F. Feeder conduit should enter from the top or bottom, close to one side; never in the center. Distribution conduit should enter in the center.
- G. Conduit for outlets shall turn toward the main pathway and have an insulated bushing installed.

3.4 MISCELLANEOUS

- A. Raceway systems shall be bonded to the telecommunication grounding system per NEC Article 250, EIA/TIA-607 Standard, and Specification Section 27 05 26, Grounding & Bonding for Communications Systems.
- B. Provide a 1/8-inch nylon or polypropylene line in all conduits.
- C. Where cable tray is specified, or conduits are routed back to MDF or IDF Rooms or extended beyond the stub-out (greater than 3 feet from wall), install grounding bushing and bond to telecommunication grounding system.

3.5 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Communications penetrations occur when pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeve opening.
- D. Fire-Rated Assemblies: 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. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Furnish and install pipe sleeves as shown on the drawings. The sleeves shall extend 4 inches above the floor and a minimum of 2 inches below the bottom of the ceiling slab. The inner edges of the sleeve shall be reamed, providing a smooth surface to prevent damage to cable insulation. Sleeves shall be equipped with metal caps to ensure fireproofing between floors and/or insulated bushings when occupied with cable.
- G. 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.
- H. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 specifications.
- I. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetrations. Install sleeves and seal pathway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 specifications.
- J. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- K. 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.

- L. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

- A. Communications penetrations occur when pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install 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. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Furnish and install pipe sleeves as shown on the drawings. The sleeves shall extend 4 inches above the floor and a minimum of 2 inches below the bottom of the ceiling slab. The inner edges of the sleeve shall be reamed, providing a smooth surface to prevent damage to cable insulation.
- G. Sleeves shall be equipped with metal caps to ensure fireproofing between floors and/or insulated bushings when occupied with cable.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
- I. 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 pathway or cable, using joint sealant appropriate for size, depth, and location of joint.
- K. Comply with requirements in Division 07 specifications.
- L. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 specifications.
- M. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- N. 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.
- O. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between pathway or cable and sleeve for installing mechanical sleeve seals.
- P. Install to seal exterior wall penetrations.

1. Use type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway of cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathways or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistances rating of assembly. Firestopping materials and installation requirements are specified in Division 07 specifications.

END OF SECTION

SECTION 27 05 26

GROUNDING & BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section outlines the requirements of the telecommunication grounding work as indicated on the drawings and in the contract documents.

1.2 RELATED DOCUMENTS

- A. Division 26 sections as applicable shall apply to work of this section.

1.3 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in the manufacture of electrical connectors, terminals, and fittings, of types and ratings required, and ancillary grounding materials, including stranded cable, copper braid and bus, ground rods, and plate electrodes, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. NEC Compliance: Comply with NEC requirements as applicable to materials and installation of data/telecommunication grounding systems, associated equipment, and wiring. Provide grounding products which are UL listed and labeled.
- C. UL Compliance: Comply with applicable requirements of UL 467 and UL 869, pertaining to data/telecommunication grounding and bonding.
- D. TIA/EIA Compliance: Comply with TIA/EIA-607 Standards and the BICSI Telecommunications Distribution Methods Manual (TDMM) for the installation of data/telecommunication grounding and bonding systems.

PART 2 - PRODUCTS

2.1 TELECOMMUNICATION GROUNDING SYSTEM

- A. Provide a low-impedance telecommunication grounding system with a stable ± 0 volt to ground signal reference point for communication system equipment and infrastructures.
- B. Telecommunication bonding backbone (TBB) shall be sized per NEC Table 250-66 (based on largest service entrance conductor or equivalent area for parallel conductors), minimum of a #2 AWG copper conductor.
- C. All bonding conductors shall be minimum #6 AWG, insulated (green jacket), stranded copper.
- D. In multi-story buildings requiring two or more vertical MDFs, IDF, and/or TBBs, they shall be bonded together at the top and bottom floors, with a minimum of every third floor when the building exceeds four floors.
- E. System connections shall be irreversible compression-type connectors or exothermic welding with bronze bolt, star washer, and nut connection hardware.

- F. Zinc-clad or nickel-plated steel hardware is not acceptable.
- G. Setscrew, box lug, and split-bolt connectors are not acceptable.
- H. Where required by local code interpretation, the data/telecommunication grounding system backbone cable conductor shall be a bare stranded copper conductor in lieu of an insulated conductor when installed in open cable trays and/or exposed in a return air plenum space or riser rated space. The Contractor shall verify requirements and coordinate with the Engineer.
- I. 2-hole compression lugs shall be utilized for backbone cable terminations of #2 AWG and larger. 1-hole compression lugs may be utilized for cable terminations of #6 up to #2 AWG.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Bonding and grounding conductors installed in ferrous metallic conduit shall be bonded at each end of conduit, utilizing a minimum #6 AWG copper conductor and bond bushings. Conduits less than 3 feet in length shall be bonded at one end. Bond bushing lug shall be replaced with a compression-type ground lug, bolted to bushing with bronze machine screw and star washer.
- B. Bonding and grounding conductor splices shall be kept to a minimum. All splices shall be located in the telecommunication spaces only and shall be fully accessible.
- C. Bonding conductors shall be individually routed to each piece of equipment.
- D. Conductors shall terminate onto dedicated grounding lugs, one conductor per termination.
- E. All conductors shall be maintained as short and as straight as possible.
- F. Conductors shall be free from loops and coils; no bend shall be greater than 90 degrees.
- G. The data/telecommunication grounding system shall be extended to and through data/communication raceways, such as cable trays, cable channels, ladder systems, metallic surface-mounted raceways, etc., by means of extending a #6 AWG minimum bonding conductor through the length of the raceway system and bonding to each section of raceway, lugging at 10-foot maximum intervals along the length of the raceway, and lugging to any section of raceway greater than 3 feet in length, in lieu of the installation of individual bonding jumpers between each raceway section.
- H. Where a bare copper TBB conductor or bonding conductor is routed through a cable tray system, the conductor shall be tied down and anchored to the cable tray, 36 inches maximum on center, utilizing a UL listed wire fastener as required.
- I. The data/telecommunication grounding system shall meet the requirements of NEC Articles 250 and 800. The Contractor shall bond individual electronic components and equipment to the grounding system per the equipment manufacturer's recommendations and instructions.
- J. Each telecommunication bonding conductor shall be labeled. Labels shall be located on conductors, as close as practicable to their point of termination. Label shall be non-metallic and include the following information: "WARNING – IF THIS CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED, PLEASE CALL THE BUILDING TELECOMMUNICATION MANAGER."

- K. Items to be bonded to the data/telecommunication grounding system at the ground distribution bus bars shall include, but not be limited to, the following:

1. Telephone equipment (e.g., PBXs, KSUs, ISDN equipment, etc.).
2. CATV equipment.
3. Equipment racks and cabinets.
4. Cable ladders, trays, and channels.
5. Surface-mounted metallic raceways and wireways.
6. Metallic conduit systems.
7. Service entrance protected terminals.
8. Telecommunications and fiber-optic splice enclosures.
9. Inter-building cable sheaths and messengers.
10. Coupled bonding conductors.
11. Paging and access control systems.

3.2 SYSTEM TESTING

- A. Upon completion of the installation of the data/telecommunication grounding system and/or servicing of the existing grounding systems, the Contractor shall perform approved standard ground resistance tests with an Engineer-approved ground resistance test unit (i.e., stakeless clamp-on ground resistance tester, 3-point fall of potential tester), using approved procedures as noted in this specification.
- B. The Contractor shall perform telecommunication grounding system testing as follows:
1. Measure ground current and ground resistance readings on all TBB conductors at each telecommunications main grounding bus bar.
 2. Measure ground current and ground resistance readings on all bonding jumpers at each telecommunications main grounding bus bar.
 3. Record all readings in a Test Report.
 4. Where test results indicate a ground current of 1 amp or greater, the Contractor shall take appropriate action to identify and reduce the ground current to less than 1 amp. The Contractor shall notify the Engineer in writing of the excessive ground current, the source, and the action taken to reduce the current.
- C. The Contractor shall demonstrate to the Owner or Owner's representative, by testing, that the data/telecommunication ground system to earth resistance value is 10 ohms or less, utilizing a "clamp-on" or 3-point fall of potential tester.
- D. The Contractor shall be able to demonstrate to the Owner or Owner's representative, by test, that the data/telecommunication grounding system resistance from any grounded non-current-carrying conductor in the system to the electrical service entrance neutral/ground bonding conductor is less than 0.1 ohm.
- E. The Contractor shall record the test results in a Test Report, and provide a description of the testing procedures for submission to the Engineer for approval.

- F. The Contractor shall include copies of the completed and approved Test Report in the Instruction Manuals.

END OF SECTION

SECTION 27 05 28

PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Communications equipment coordination and installation.
 - 2. Sleeves for pathways and cables.
 - 3. Raceway systems.
 - 4. Common communications installation requirements.
- B. Related Sections:
 - 1. Specification Section 27 05 26, Grounding & Bonding for Communications Systems.
 - 2. Specification Section 26 05 33, Raceway & Boxes for Electrical Systems.
 - 3. Specification Section 26 05 53, Identification for Electrical Systems.

1.3 QUALITY ASSURANCE

- A. NEC Compliance: Comply with NEC as applicable to Communication System Materials and Installation.
- B. NEMA Compliance: Comply with applicable portions of NEMA Standards pertaining to Types of Electrical Equipment Enclosures.
- C. EIA/TIA-569A Compliance: Comply with EIA/TIA-569A Standards for Telecommunication Pathways and Spaces for Commercial Buildings.

1.4 SUBMITTALS

- A. Product Data: For sleeves, seals, cable ladder, and back boxes.

1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of communications 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 pathways, 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 communications item that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 specifications.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 specifications.
- E. Conduit systems shall be color coded the entire length. Conduit shall be factory anodized in color as stated in Specification Section 26 05 53, Identification for Electrical Systems.
 - 1. As an option, the Contractor may use natural colored conduit with painted markings every 5 feet.
 - 2. Where conduit system is painted, all junction boxes shall be required to be painted to match system color. On junction boxes that are larger than 16 inches square, only the cover of the box need be painted.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR COMMUNICATIONS 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: Installed to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right-of-Way: Give to piping systems installed at a required slope.

3.2 CABLE LADDER

- A. Cable ladders shall be installed per manufacturer's instructions, utilizing product series accessories and components.
- B. Cable ladders, supports, and brackets shall be cleanly cut, deburred, and sharp edges removed.
- C. Verify installed loading requirements and install the raceway system per the manufacturer's recommendations. Provide additional load capacity to support a 2X growth factor.

- D. Install end caps, mounting spacers, couplings, hangers, brackets, dropouts, connectors, supports, and other manufacturer's accessories as required to provide a complete and functioning installation.

3.3 CONDUIT

- A. Conduit shall be sized per Table 1 below, or as noted on the drawings. Where sections of conduit runs are longer than 100 feet, or have more than 180 degrees of bends, or have a reverse bend (greater than 90 degrees), pull boxes shall be provided and installed. Bends in conduit larger than 2 inches shall be long sweep type. Except where specifically noted, the inside radius of bends shall not be less than:

1. Six times the internal diameter of conduits 2 inches and smaller.
2. Ten times the internal diameter for conduits 2-1/2 inches and larger.

TABLE 1.											
Inside Diameter in mm	Trade Size	Cable Outside Diameter in mm (inches)									
		3.3 (0.13)	4.6 (0.18)	5.6 (0.22)	6.1 (0.24)	7.4 (0.29)	7.9 (0.31)	9.4 (0.37)	13.5 (0.53)	15.8 (0.62)	17.8 (0.70)
16	1/2	1	1	0	0	0	0	0	0	0	0
21	3/4	6	5	4	3	2	2	1	0	0	0
27	1	8	8	7	6	3	3	2	1	0	0
35	1-1/4	16	14	12	10	6	4	3	1	1	1
41	1-1/2	20	18	16	15	7	6	4	2	1	1
53	2	30	26	22	20	14	12	7	4	3	2
63	2-1/2	45	40	36	30	17	14	12	6	3	3
78	3	70	60	50	40	20	20	17	7	6	6
91	3-1/2							22	12	7	6
103	4							30	14	12	7

- B. Conduits entering telephone and data closets shall terminate as close as possible to the wall through which the conduits enter, unless otherwise noted. In-floor conduit shall terminate 4 inches above finish floor (AFF) or curb unless noted otherwise. All conduits shall be left clean, dry, and free of debris or other obstructions, with insulated grounding bushings installed.
- C. Pull boxes shall be sized and installed per BICSI Standards.
- D. Conduit, sleeves, and stubs through fire rated floors and walls shall be rigid galvanized steel conduit with insulated and/or grounding bushings per specifications. Conduit sleeve shall extend a minimum of 6 inches beyond each wall surface. Upon completion of the work, install fire stop per specifications and codes.
- E. Furnish and install pipe sleeves as shown on the drawings. The sleeves shall extend 4 inches above the floor and a minimum of 2 inches below the bottom of the ceiling slab. The inner edges of the sleeve shall be reamed, providing a smooth surface to prevent damage to cable insulation. Sleeves shall be equipped with metal caps to ensure fireproofing between floors and/or insulated bushings when occupied with cable.
- F. Feeder conduit should enter from the top or bottom, close to one side; never in the center. Distribution conduit should enter in the center.
- G. Conduit for outlets shall turn toward the main pathway and have an insulated bushing installed.

3.4 MISCELLANEOUS

- A. Raceway systems shall be bonded to the telecommunication grounding system per NEC Article 250, EIA/TIA 607 Standard, and Specification Section 27 05 26, Grounding & Bonding for Communications Systems.
- B. Provide a 1/8-inch nylon or polypropylene line in all conduits.
- C. Where cable tray is specified, or conduits are routed back to MDF or IDF Rooms or extended beyond the stub-out (greater than 3 feet from wall), install grounding bushing and bond to telecommunication grounding system.

3.5 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Communications penetrations occur when pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeve opening.
- D. Fire-Rated Assemblies: 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. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Furnish and install pipe sleeves as shown on the drawings. The sleeves shall extend 4 inches above the floor and a minimum of 2 inches below the bottom of the ceiling slab. The inner edges of the sleeve shall be reamed, providing a smooth surface to prevent damage to cable insulation. Sleeves shall be equipped with metal caps to ensure fireproofing between floors and/or insulated bushings when occupied with cable.
- G. 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.
- H. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 specifications.
- I. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetrations. Install sleeves and seal pathway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 specifications.
- J. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- K. 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.

- L. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

- A. Communications penetrations occur when pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install 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. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Furnish and install pipe sleeves as shown on the drawings. The sleeves shall extend 4 inches above the floor and a minimum of 2 inches below the bottom of the ceiling slab. The inner edges of the sleeve shall be reamed, providing a smooth surface to prevent damage to cable insulation.
- G. Sleeves shall be equipped with metal caps to ensure fireproofing between floors and/or insulated bushings when occupied with cable.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
- I. 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 pathway or cable, using joint sealant appropriate for size, depth, and location of joint.
- K. Comply with requirements in Division 07 specifications.
- L. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 specifications.
- M. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- N. 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.
- O. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between pathway or cable and sleeve for installing mechanical sleeve seals.
- P. Install to seal exterior wall penetrations.

1. Use type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway of cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathways or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistances rating of assembly. Firestopping materials and installation requirements are specified in Division 07 specifications.

END OF SECTION

SECTION 27 05 44

SLEEVES & SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS & CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves for pathway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Division 07 specifications, for penetration firestopping installed in fire resistance rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.2 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.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A53/A53M, 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 on the board.

C. Sleeves for Rectangular Openings:

1. Material: Galvanized steel sheet.
2. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangular perimeter less than 50 inches (1,270 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 (1,270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. Advance Products & Systems, Inc.
 - b. CALPICO, Inc.
 - c. The Metraflex Company.
 - d. Pipeline Seal and Insulator, Inc.
 - e. Proco Products, Inc.
 - 2. Sealing Elements: EPDM Nitrile or Buna N rubber 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.
 - 4. 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.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 - a. Presealed systems.

2.4 GROUT

- A. Description: Non-shrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume adjusting, dry, hydraulic cement grout.
- C. Design Mix: 5,000 psi (34.5 MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single component, silicone based, neutral curing elastomeric sealants of grade indicated below:
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

2. Sealant shall 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: Multi-component, silicone based liquid elastomers that when mixed, expand and cure in place to produce flexible, non-shrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for conduits penetrating above grade non-fire-rated concrete and masonry unit floors and walls:
1. Interior penetrations of non-fire-rated walls and floors:
 - a. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 specifications.
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pathway or cable unless sleeve seal is to be installed.
 4. Install sleeves for all penetrations unless core drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved openings.
 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior Wall Penetrations: Seal penetration 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.
- 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 pathway 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 pathway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE SEAL FITTING INSTALLATION

- A. Install sleeve seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve seal fittings.

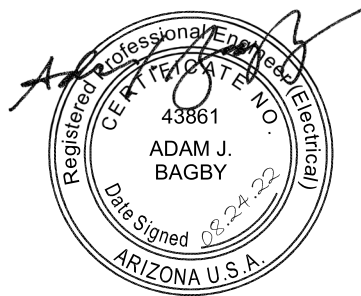
END OF SECTION

DIVISION 28

ELECTRONIC SAFETY & SECURITY

28 05 00	Common Work Results for Electronic Safety & Security
28 05 00	General Provisions
28 05 01	Scope of Work
28 05 02	Temporary & Remodeling Work
28 05 05	Low-Voltage Open Wiring Systems
28 05 93	Testing of Duct Detectors & Smoke/Fire Dampers
28 46 00	Fire Detection & Alarm
28 46 00	Fire Detection & Alarm
28 46 24.23	Firefighter's Smoke Control Station

END OF INDEX



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SECTION 28 05 00
GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SCOPE

- A. Provisions of this section apply to all work specified in all sections under Division 28.
- B. In addition, work in Division 28 is governed by the provisions of the Bidding Requirements, Contract Forms, General Conditions, and all sections under Division 01.
- C. Fire alarm equipment coordination and installation.

1.2 DEFINITIONS

- A. Exposed, not concealed.
- B. Finished Spaces: Spaces other than mechanical, electrical, and communication equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and utility tunnels.
- C. Exposed, Interior Installations: Exposed to view indoors. Examples include unfinished spaces, mechanical, electrical, and communication equipment rooms.
- D. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations and equipment yards.
- E. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- F. 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.
- G. Unfinished Space: A room or space that is ordinarily accessible only to building maintenance personnel, a room noted on the "Finish Schedule" with exposed and unpainted construction for walls, floors, or ceilings, or specifically mentioned as "unfinished."

1.3 EXAMINATION OF PREMISES

- A. Visit the site, verify all measurements and job conditions, and pay all costs necessary to perform the work.

1.4 FIRE ALARM CONTRACTOR

- A. The Fire Alarm Contractor shall be licensed and hold a current contracting license that has been valid for a minimum of 2 years in the State of Arizona as a Fire Alarm Contractor.

1.5 REGULATIONS, PERMITS, FEES, CHARGES, INSPECTIONS

- A. Regulations: Comply with all applicable codes, rules, and regulations.

- B. Fees and Permits: Pay all connection, installation, use, development, etc., fees and/or charges. Obtain and pay for all required permits and licenses. Refer to Division 01 specifications.
- C. Inspections: All work must be inspected and approved by local authorities. Prior to final approval, furnish the Architect with certificates of inspections and approvals by the local authorities in accordance with Division 01 specifications.

1.6 DRAWINGS AND SPECIFICATIONS

- A. If a conflict exists on the drawings or between the drawings and specifications, promptly notify the Architect.

1.7 SUBMITTALS

- A. Submittals are for information and coordination only. The Engineer will diligently review the submittals and attempt to verify compliance with the project requirements. Such review, however, does not constitute approval or disapproval or obligation to comply with all project requirements. The submittals are not to be construed to be contract documents. Any failure by the Engineer to note a point of non-compliance shall not be construed to be acceptance or approval of the discrepancy.
- B. Product Information Sheets: Provide manufacturer's literature, which includes the information required by the Product Data paragraph of the applicable specification section. Where Product Information Sheets show multiple models or options, clearly mark the model and options to be provided.
- C. Assembly: Assemble all required submittal information for each specification section and submit in PDF format.
 - 1. Assemble PDF submittals in one PDF file for each division. Separate and order sections within each file by corresponding specification number. Provide bookmarks at the first page of each section and label each bookmark with the specification number and name to allow for easy navigation of the submittal.
 - 2. Partial submittals will be returned without review. Floor plans with calculations may be submitted for the fire alarm system separately.
- D. Identification and Information:
 - 1. Name the PDF file with the project name, division number and sequential submittal number (i.e., the first submittal shall be No. 1; the second submittal shall be No. 2.).
 - 2. Provide a cover sheet at the front of each submittal with the following information:
 - a. Project name.
 - b. Date.
 - c. Name of Engineer.
 - d. Name of Contractor.
 - e. Name of subcontractor.
 - 3. Provide a cover sheet at the front of each submittal section with the following information:
 - a. Name of supplier.
 - b. Name of manufacturer.
 - c. Number and title of appropriate specification section.
 - d. Drawing number and detail references, as appropriate.
 - e. Other necessary identification.

E. Options:

1. Identify options requiring selection by the Engineer.
2. Identify options included with submittal item.

F. Deviations: Identify deviations from the Contract Documents on submittals.

1.8 MATERIAL SAFETY DATA SHEETS

A. Provide current Material Safety Data Sheets (MSDS) for all hazardous chemicals that are proposed for use at the project site.

1. Provide one complete set to the Owner for review and approval a minimum of 1 week prior to the delivery of any hazardous chemicals to the site.
2. Maintain a second complete set at the project location, readily accessible by both the Owner's personnel and the Contractor's personnel.

1.9 REQUEST FOR INFORMATION

A. Request for Information:

1. A document submitted by the Contractor requesting clarification of a portion of the Contract Documents, hereinafter referred to as RFI.
2. A properly prepared RFI shall include a detailed written statement of the clarification, apparent conflict, or information requested that indicates the specific drawings or specification in need of clarification and the nature of the clarification requested.
 - a. Drawings shall be identified by drawing number and location on the drawing sheet.
 - b. Specifications shall be identified by section number, page, and paragraph.
3. Include a proposed solution, where appropriate, based upon the field conditions and best knowledge of the Contractor.

B. Improper or Frivolous RFIs: RFIs which are not properly prepared or that request information which is clearly shown in the Contract Documents will be returned unanswered. Processing time for multiple submissions of improper or frivolous RFIs will be billed at the Engineer's standard hourly rate to the Owner who may deduct an equal amount from the monies due the Contractor.

1.10 AS-BUILT DRAWINGS

A. As-Built Drawings: Maintain one set of marked-up paper copies of the Contract Drawings.

1. Preparation: Mark As-Built Drawings to show the actual installation where installation varies from that shown originally. Include all equipment, and underground and overhead conduit.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Include dimensions both horizontally and vertically to permanent points of reference, accurate within 6 inches. Include descriptors such as "below slab," "above ceiling," etc.
 - c. Record data daily or as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.

2. Mark the As-Built Drawings completely and accurately. Utilize personnel proficient at recording graphic information in production of As-Built Drawings.
 3. Mark the As-Built Drawings with erasable, red colored pencil, or in a digital PDF format using an editor program such as Bluebeam, Adobe Acrobat Professional, or similar. Use other colors to distinguish between changes for different categories of the work at the same location.
 4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
 5. Update the As-Built Drawings weekly or daily as appropriate for the project size.
- B. Format: Identify and date each As-Built Drawing; include the designation "PROJECT AS-BUILT DRAWING" in a prominent location.
1. Organize newly-prepared As-Built Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Identification, as follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT AS-BUILT DRAWINGS."
 - d. Name of Engineer.
 - e. Name of Contractor.
 3. Remove or obscure the Engineer's seal and signature from As-Built Drawings.

1.11 RECORD DRAWINGS

- A. Record Drawings: Immediately before inspection for Certificate of Substantial Completion, submit final marked-up As-Built Drawings to the Architect for review. When authorized, prepare a full set of corrected Record Drawings of the Contract Drawings, as follows:
1. Utilize the same digital data software program, version, and operating system as for the original Contract Drawings to incorporate changes and additional information previously marked on As-Built Drawings. Delete, redraw, and add details and notations where applicable.
 2. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
 3. Refer instances of uncertainty to the Architect for resolution.
 4. Format: Provide Digital Record Drawing files in both DWG and PDF format. Organize Record Drawing information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
- B. Record Drawings Submittal:
1. Submit Digital Record Drawings and three sets of Record Drawing plots.
 2. Plot each drawing file, whether or not changes and additional information were recorded.

1.12 OPERATION AND MAINTENANCE MANUAL

- A. Prior to completion of the project, compile a complete equipment Operation and Maintenance Manual for all equipment supplied under Division 28.

B. Schedule:

1. Submit a preliminary copy of the manual not less than 30 days prior to Substantial Completion for review and comment.
2. Submit the final version of the manual not more than 4 weeks after Substantial Completion of the project.

C. Format:

1. Submit manuals in both of the following formats:
 - a. PDF electronic file. Assemble each manual into a composite electronically-indexed file. Submit on digital media acceptable to the Engineer.
 - 1) Name each indexed document file in the composite electronic index with applicable item name. Include a complete electronically-linked operation and maintenance directory.
 - 2) Enable inserted reviewer comments on draft submittals.
 - 3) Provide one final copy to the Engineer and two copies to the Owner.
 - b. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. The Engineer will return three copies.

D. Provide Operation & Maintenance Manuals for all systems, subsystems, and equipment that require operation and regular maintenance, or have replaceable parts.

E. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, product data, manufacturer's 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. In addition to requirements in this section, include operation and maintenance data required in individual specification sections.

F. Source Information: List each system, subsystem, and piece of equipment included in the manual, identified by product name and arranged to match the manual's table of contents. For each product, list the name, address, and telephone number of the installer or supplier and maintenance service agent, and cross-reference the specification section number and title in the Project Manual.

G. Product Data: Include the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on the Contract Documents.
2. Approved submittals.
3. Include the following if not shown on approved submittals:
 - a. Product name and model number. Use designations for products indicated on the Contract Documents.
 - b. Manufacturer's name.
 - c. Equipment identification with serial number of each component.
 - d. Equipment function.
 - e. Operating characteristics.
 - f. Limiting conditions.
 - g. Performance curves.

- h. Engineering data and tests.
- H. Operating Procedures:
 - 1. Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Instructions on stopping.
 - f. Normal shutdown instructions.
 - g. Seasonal and weekend operating instructions.
 - h. Required sequences for electric or electronic systems.
 - i. Special operating instructions and procedures, including precautions against improper use.
 - j. Operating logs.
- I. Wiring Diagrams: Diagram of factory-installed wiring, including any options as well as any field modifications.
- J. Systems and Equipment Controls: Describe the sequence of operation and diagram controls as installed.
- K. Manufacturer's Maintenance Documentation: Manufacturer's 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.
- L. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.
 - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - 5. Aligning, adjusting, and checking instructions.
 - 6. Demonstration and training video recording, if available.
- M. 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.
- N. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturer's maintenance documentation and local sources of maintenance materials and related services.
- O. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

- P. Licenses: Include copies of any licenses with requirements, including inspection and renewal dates.
- Q. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
- R. Test and Balance Report: Include a final, approved copy of the Test and Balance Report.

1.13 WORK AND MATERIALS

- A. Unless otherwise specified, all materials must be new and of the quality specified. The workmanship shall be of a quality that is acceptable to the Architect, Engineer, and Owner, and is equal to the standards of the trades. Contractor must staff the project with sufficient skilled workmen, including a fully qualified construction superintendent, to complete the work in the time allotted. The superintendent must be qualified to supervise all of the work in his work category.
- B. Uniformity: Unless otherwise specified, provide all equipment and products of the same type or classification by the same manufacturer.

1.14 APPROVALS OF MATERIALS AND EQUIPMENT

- A. Refer to Division 01 specifications for description of material and equipment for prior approvals and substitutions.

1.15 COOPERATIVE WORK

- A. Correct without charge any work requiring alteration due to lack of proper supervision or failure to make proper provision in time. Correct without charge any damage to adjacent work caused by the alteration. Refer to Division 01 specifications for additional requirements.
- B. Cooperative work includes:
 - 1. General supervision and responsibility for proper location, rough-in, and size of work related to Division 28 but provided under other divisions of these specifications.
 - 2. Installation of sleeves, inserts, and anchor bolts for work under sections in Division 28.

1.16 EXISTING MATERIALS AND EQUIPMENT

- A. Disposition: With the exception of items that are to be reused or retained by the Owner, all other materials indicated to be removed shall be removed and disposed of by the Contractor. Items that are indicated to be retained or returned to the Owner shall be delivered to a storage area designated by the Owner.
- B. Unused Materials: All unused raceways, conductors, boxes, equipment, and miscellaneous materials shall be removed by the Contractor except where located within walls, below or above existing construction which is not being altered and would require removal and replacement of this existing construction. All visible raceways, conductors, boxes, equipment, and miscellaneous materials shall be removed and sealed or capped within wall, below floor unless noted otherwise.
- C. Exterior Services: The Contractor shall be responsible for maintaining fire alarm service to the existing building during the construction period. Existing services are to be retained until such a time that the new services, if any, are completely installed and ready for use. Scheduling of service interruptions is to be coordinated with the Architect and Owner.

- D. Disconnect, demolish, and remove fire alarm systems, equipment, and components that are indicated to be removed.
 - 1. Conduit to be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material. Patch insulation, as required, to match adjacent areas.
 - 2. Conduit to be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Equipment to be Removed: Disconnect services and remove equipment.
 - 4. Equipment to be Removed and Reinstalled: Disconnect and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 5. Equipment to be Removed and Salvaged: Disconnect and remove equipment and deliver to Owner.
- E. Continuity of Services in Existing Buildings: Contractor shall permanently reroute existing fire alarm services or provide temporary connection as required to maintain service to existing fixtures in buildings which are to remain in service.
- F. Rerouting and Relocation of Existing Fire Alarm Equipment and Services in Existing Buildings:
 - 1. General: Contractor shall reroute/relocate all existing materials which are in conflict with the building alterations and which are required to be maintained in use.
 - 2. Existing Raceways and Conductors: Where applicable, existing material may be reused in its original location unless otherwise indicated.
- G. Testing: All existing services affected by the new construction and which are to remain in operation shall be returned to their original condition. The existing services shall be tested as new, as described in other sections of these specifications. If for any reason these requirements cannot be met, the Contractor shall immediately notify the Architect.

1.17 CONSTRUCTION FACILITIES

- A. General: Under this division of the specifications, execute all work in a manner to provide safe and lawful ingress and egress to the Owner's establishment and such facilities shall be kept clear of materials or equipment. Refer to Division 01 specifications for additional requirements.
- B. Furnish and maintain, from the beginning to the completion of all work, all lawful and necessary guards, railings, fences, canopies, lights, and warning signs. Take all necessary precautions required by city and state laws to avoid injury or damage to any and all persons and property.

1.18 GUARANTEE

- A. Guarantee, in writing, all material, equipment, installation, and workmanship for all sections under Division 28 to be free from defects of material and workmanship for 1 year from the date of final acceptance as outlined in Division 01 specifications. Equipment warranties shall be a minimum of 1 year from the date of Substantial Completion or as specified elsewhere. Replace without charge any material or equipment proving defective during this period. The guarantee shall include performance of the equipment under all conditions of load, installing any additional items of control and/or protective devices as required, and the replacing of any refrigerant lost.

PART 2 - PRODUCTS

2.1 CONCRETE

- A. Where used for structures to be provided under the contract such as bases, etc., concrete work and associated reinforcing shall be as specified under that division.
- B. Refer to other sections for additional requirements for underground vaults, cable ducts, etc.

2.2 FRAMING CHANNEL

- A. The framing channel shall be a cold-rolled, high-quality, carbon steel channel with factory-applied, hot-dipped-after-fabrication finish. Utilize factory-built inter-connecting components, mounting straps, connectors, etc., designed for use with the framing channel supplied. Channel nuts shall be spring type and shall utilize standard US threads. Provide heavy zinc paint for field touchup. B-Line "B" Series, Unistrut "P" Series, or as accepted by the Architect.

2.3 ANCHORS

- A. Anchors shall be expandable lead type as manufactured by Ackerman-Johnson, Diamond, Hilti, Pierce, or as accepted by the Architect.
- B. Adjustable concrete hanger inserts shall be as manufactured by Grinnell or as accepted by the Architect.

PART 3 - EXECUTION

3.1 SUBMITTALS

- A. Prepare submittals as directed for review by the Contractor, Owner, Architect, and Engineer.
- B. Submit one copy of PDF submittals via email, project website, or other electronic media.

3.2 RECORD DOCUMENTS

- A. Recording: Post changes and modifications to the project Record Documents as they occur; do not wait until the end of the project.
- B. Maintenance of Record Documents and Samples: Store Record Documents in the field office, apart from the Contract Documents used for construction. Do not use project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project Record Documents for the Engineer's reference during normal working hours. As-Built Drawings will be reviewed by the Architect, Owner, and Engineer at each pay request review.
- C. Submit As-Built Drawings to the Architect for approval before completion of Record Drawings.
- D. Secure the Record Drawings in a red-enameled steel cabinet adjacent to the fire alarm panel at completion of the project.

3.3 OPERATION AND MAINTENANCE MANUALS

- A. Prepare Operation & Maintenance Manuals as directed for review by the Contractor, Owner, Architect, and Engineer.
- B. Make corrections and resubmit as required.

3.4 VERIFICATION OF DIMENSIONS

- A. Scaled and figured dimensions are approximate only. Before proceeding with work, carefully check and verify dimensions at the site, and be responsible for properly fitting equipment and materials together and to the structure in spaces provided.
- B. Drawings are diagrammatic and many offsets, bends, special fittings, and exact locations are not indicated. Carefully study drawings and premises in order to determine the best methods, exact locations, routes, and building obstructions, and install apparatus and equipment in available locations. Install apparatus and equipment in a manner and in locations to avoid obstructions, preserve headroom, and keep openings and passageways clear.

3.5 CUTTING AND PATCHING

- A. Cut work and patch per Division 01 specifications as necessary to properly install the new work. As the work progresses, coordinate necessary openings, holes, chases, etc., in their correct location. If the required openings, holes, and chases are not in their correct locations, make the necessary corrections at no cost to the Owner. Avoid excessive cutting and do not cut structural members without the consent of the Architect. Include as a part of the work all structural framing required by penetrations through the roof and necessary steel to support ducts and pipes between structural steel unless shown on the structural drawings.

3.6 CLOSING-IN OF UNFINISHED WORK

- A. Cover no work until inspected, tested, and approved. Where work is covered before inspection and test, uncover it, and when inspected, tested, and approved, restore all work to original proper condition.

3.7 EXCAVATION AND BACKFILL

- A. Perform all necessary excavation, shoring, and backfilling required for the proper laying of all raceways, ducts, and conduits inside the building and premises, and outside as may be necessary. Remove all excess excavated materials from the site or dispose of onsite as directed by the General Contractor.
- B. Excavate all trenches open cut, keep trench banks as nearly vertical as practicable, and sheet and brace trenches where required for stability and safety. Excavate trenches true to line and make bottoms not less than 18 inches wide but no wider than necessary to provide ample work room. Grade trench bottoms accurately to provide uniform bearing and support for each section of pipe on undisturbed soil along its entire length. Dig "bell" holes after the trench bottom has been graded. Machine grade only to the top line of the raceways, doing the balance by hand. Do not cut any trench near or under footings without first consulting the Architect. Comply with OSHA requirements.
- C. Provide not less than 4 inches of granular material as pipe bedding prior to laying pipe in trench to continuously support pipe and maintain required slope. Granular material shall be pea gravel or sand per MAG Standards.

- D. Provide backfilling and compaction in accordance with provisions of these specifications and under the direction of the Architect to the required density.
- E. Provide not less than 4 inches of granular material, same as piping bedding, all around pipe. Make the first 2 feet of fill in 6-inch layers, each thoroughly compacted as directed, and free from rocks, large clods of earth, leaves, branches, and debris. Compact the rest of the backfill as directed, using in the backfill no rocks larger than 4 inches in diameter, and using no rock in the top 12 inches.

3.8 ACCESSIBILITY

- A. Install all control devices or other specialties requiring reading, adjustment, inspection, repairs, removal, or replacement conveniently and accessibly throughout the finished building. Where any of these devices are shown on the Contract Drawings to be installed above any inaccessible ceiling or behind any inaccessible wall, the Fire Alarm Contractor shall furnish access doors or panels as required.
- B. All access doors or panels in walls and ceilings required for access to control devices, traps, valves, and similar devices are to be furnished and installed as part of the work under this section. Provide type as specified in Division 08 specifications.
- C. Refer to architectural drawings for type of wall and ceiling in each area and for rated construction.
- D. Coordinate work of various sections to locate valves, traps, and dampers with others to avoid unnecessary duplication of access doors.
- E. The Contractor, along with the Owner's representative, shall complete the Division 28 Accessibility/Clearance Checklist at the end of this section for all fire alarm equipment. The chart shall be submitted to the Architect for approval prior to Substantial Completion. All conflicts shall be resolved to the Architect's and Owner's satisfaction prior to submission.
- F. Provide doors that pierce a fire separation with the same fire rating as the separation.

3.9 ROOF FLASHINGS

- A. Flash and counterflash all piping, conduits, and ductwork penetrating roofing membrane with flashing per roofing manufacturer's recommendations. Refer to architectural drawings for detailing of duct and pipe penetrations through roof.

3.10 PRODUCT AND EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. All equipment, valves, sensors, dampers, detectors, etc., shall be installed in strict conformance with the manufacturer's recommendations and all codes.
- B. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- D. Install fire alarm equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations.
- E. Do not install any equipment in an application not recommended by the manufacturer.

3.11 EQUIPMENT ROUGH-IN

- A. Rough in all equipment and fixtures as designated on the drawings and in the specifications. The drawings indicate only the approximate location of rough-ins. The exact rough-in locations must be determined from large-scale certified drawings. The Contractor shall obtain all certified rough-in information before progressing with any work for rough-in final connections.
- B. Be responsible for providing all outlets and services of proper size at the required locations.
- C. Minor changes in the Contract Drawings shall be anticipated and provided for under this division.
 - 1. Rough-in only (unless otherwise designated on the drawings) shall include providing all services as indicated and required, including all conduit and conductors. Cap all conduit stub-outs in a manner suitable for future extension.

3.12 EQUIPMENT FINAL CONNECTIONS

- A. Provide all final connections for the following:
 - 1. All equipment furnished under this division.
 - 2. Fire alarm equipment furnished under other sections of the specifications (except as otherwise designated).
 - 3. Owner-furnished equipment as shown on the drawings.

3.13 OWNER-FURNISHED AND OTHER EQUIPMENT

- A. Rough-in only for all Owner-furnished equipment (refer to Division 01 specifications) and all equipment furnished under other sections of the specifications, except as otherwise specified and/or noted on the drawings.

3.14 EQUIPMENT SUPPORTS

- A. Erection of Metal Supports and Anchorages:
 - 1. Refer to Division 05 specifications for structural steel.
 - 2. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire alarm materials and equipment. Neatly fabricate and erect steel work with burrs and welding spatter ground off. Paint after fabrication with a rust-inhibitive primer.
 - 3. Field Welding: Comply with AWS D1.1.
- B. Erection of Wood Supports and Anchorages:
 - 1. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support and anchor fire alarm materials and equipment.
 - 2. 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.
 - 3. Attach to substrates as required to support applied loads.
- C. Concrete Inserts: Furnish and install all concrete inserts required for all materials and equipment specified and/or shown on the drawings for Division 28.

3.15 CLEANUP

- A. In addition to cleanup specified in Division 01 specifications, thoroughly clean all parts of the equipment. Where exposed parts are to be painted, thoroughly clean off any splattered construction materials and remove all oil and grease spots. Wipe the surface carefully and scrape out all cracks and corners.
- B. During the progress of the work, keep the premises clean and free of debris.

3.16 PAINTING

- A. Except as otherwise specified or indicated in the architectural drawings and/or specifications, paint all exposed unfinished metal with one coat of rust-inhibiting primer. Galvanized ductwork and factory-painted equipment shall be considered as having primed surface.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- C. Finished painting is specified in Division 09 specifications.

3.17 OBJECTIONABLE NOISE AND VIBRATION

- A. Construct and brace the metal partitions, ducts, and sheet metal housings to prevent vibration or rattling when systems are in operation. Install connections to equipment so noise and vibration will not reach the conditioned area through ducts, piping, conduit, sheet metal work, or the building structure.

3.18 TESTING

- A. Upon completion of the fire alarm work, the entire installation shall be tested and demonstrated to be operating satisfactorily. Tests and documentation shall be in accordance with NFPA 72, Acceptance Testing Specifications for Fire Alarm Equipment and Systems.
- B. Additional equipment-specific testing is described in the equipment's respective section of this division.
- C. Furnish a written report of testing to the Architect. At a minimum, the report shall include:
 - 1. Testing Contractor's letterhead.
 - 2. Testing technician's name and signature.
 - 3. Date and time that test was performed.
 - 4. Ambient temperature and weather conditions.
 - 5. Test equipment manufacturer, model number, and last calibration date.
 - 6. The manufacturer, model number, and, as applicable, trip unit model number and available adjustments of tested equipment.
 - 7. Statement of "As Left" conditions.
 - 8. Pass/Fail statement.
 - 9. Recommendations if any.
- D. The Contractor shall submit the testing schedule to the Architect 2 weeks prior to initiation of testing activity.

END OF SECTION

[illegible]

SECTION 28 05 01

SCOPE OF WORK

PART 1 - GENERAL

1.1 SUMMARY

- A. The work under this division includes furnishing all labor, material, and equipment necessary for the installation and placing into operation of the electrical systems as indicated on the drawings.
- B. The work shall also include the completion of such minor details of electrical work not mentioned or shown which are necessary for the successful operation of all electrical systems described on the drawings or required by these specifications.

1.2 SCOPE

- A. The work includes, but is not necessarily limited to, furnishing and installing the following:
 - 1. Complete fire alarm and all accessories, branch circuits, etc.
 - 2. All equipment and materials specified in this division.
 - 3. Empty conduit systems as indicated on the drawings.
 - 4. All other items and/or work indicated on the drawings.
 - 5. Equipment lists and maintenance manuals.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 28 05 02

TEMPORARY & REMODELING WORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Perform all temporary and remodeling work as shown on the drawings and described in the specifications, including minor items of material or equipment necessary to meet the requirements and intent of the project.
- B. All temporary and remodeling work shall be considered a part of this contract and no extra charges will be allowed.
- C. Examine architectural, structural, and mechanical drawings and specifications to determine the sequence of construction throughout the project, including existing, temporary, remodeled, and new areas.
- D. Where drawings indicate existing conditions, an attempt has been made to show electrical equipment, buildings, site details, etc., but accuracy cannot be guaranteed. Verify exact location of all conduits, outlets, etc., and all building and site details.
- E. Branch circuits shall be reused where practical and shall, in addition, be revised as required. Conceal all work where possible. Where exposed work is required in finished areas, use Wiremold raceway with #500 being the minimum size acceptable.
- F. Existing electrical wiring intended to remain in use but which will be disturbed due to construction changes required by this contract shall be restored to operating condition, as required and/or directed. Where required, shown, and/or directed, outlets and conduit runs shall be relocated. In some cases, it may be necessary to extend conduits and pull in new wiring or install junction boxes and splice in new wiring, or replace old wiring with new.
- G. Outlets from which lighting fixtures, switches, receptacles, and/or other electrical devices are removed and are not intended to be reused shall be removed or, if it is not possible to remove, a blank cover shall be placed on the outlet box. Where outlets, boxes, etc., are completely removed, the Contractor shall cut off conduits and remove wiring.
- H. Where conduits extending through floors are to be abandoned, the Contractor shall cut and cap or plug conduit so that it will not protrude above the floor.
- I. Where existing conduit is to be abandoned, the conduit shall be removed if it is exposed, in a crawl space, or in an accessible ceiling. Where it is impossible to remove the conduit, it shall be cut off and capped or plugged.
- J. The Contractor shall be held fully responsible for the proper restoration of all existing surfaces requiring patching, plastering, painting, and/or other repair due to the installation of electrical work under the terms of this specification. Close all openings, repair all surfaces, etc., as required.
- K. The Contractor shall employ qualified and experienced workmen for this work. All restoration work shall be subject to the approval of the Architect and/or the Owner.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 28 05 05

LOW-VOLTAGE OPEN WIRING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. The extent of low-voltage open wiring is indicated on the drawings, schedules, and Contract Documents.
- B. Types of low-voltage open wiring specified in this section apply to the following:
 - 1. Access control systems.
 - 2. Building management systems.
 - 3. CCTV systems.
 - 4. Fire alarm systems.
 - 5. HVAC/temperature control wiring.
 - 6. Paging/sound systems.
 - 7. Security systems.
- C. The drawings illustrate the work specified and are intended to agree in every respect with one another and with these specifications.
- D. All discrepancies that appear shall be brought to the attention of the Engineer for correction. No omission from any drawing shall release the Contractor from furnishing equipment, materials, or services called for by the specifications or other drawings.

1.2 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in the manufacture of low-voltage open wiring components of the types as specified herein and on the drawings, whose products have been in satisfactory use in similar service for not less than five years.
- B. NEC Compliance: Comply with NEC Articles 300, 640, 720, 725, 760, 770, and 800, national, state, and local codes as applicable to wiring methods, construction, and installation of low-voltage open wiring systems.
- C. NFPA Compliance: Comply with NFPA, national, state, and local codes as applicable to wiring methods, construction, and installation of low-voltage open wiring systems.
- D. UL Compliance: Comply with applicable requirements of UL Standard 83, Thermoplastic-Insulated Wires and Cables; and UL Standard 486A, Wire Connectors and Soldering Lugs for Use with Copper Conductors.
- E. Provide wiring/cabling and connector products which are ETL or UL Listed and labeled.
- F. NEMA/ICEA Compliance: Comply with NEMA/ICEA WC 5 and WC 30, pertaining to electrical type wires and cables.
- G. IEEE Compliance: Comply with applicable requirements pertaining to low-voltage open wiring systems.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Components shall be of the latest type and design manufactured for the intended use, and shall be laid out and installed such as to afford easy maintenance and/or replacement without major disassembly of adjacent components.
- B. Any deviations from the products contained in these specifications shall be noted and shall be bid as an alternate, with deducts specified.

2.2 CABLES

- A. All cables shall be in accordance with the applicable system manufacturer's specifications.
- B. Plenum-rated cables shall be used in plenum-rated ceiling spaces.
- C. Factory "shorts," scrap, or warehouse and prior project leftovers, will not be acceptable.
- D. The outer jacket of the cable shall be printed with the manufacturer's identification and required UL markings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Whenever possible, primary cable routing paths shall follow the logical structure of the building. All cable servicing an area shall be routed parallel and perpendicular to the building structure, following corridors and hallways. Diagonal runs are not acceptable.
- B. Where a wall must be breached, the cable shall pass through pre-established metal conduit sleeved openings.
- C. Corridor crossovers should be kept to a minimum.
- D. All non-plenum-rated cables must be routed in conduits through "return air plenum" spaces.
- E. It is the responsibility of the Contractor to verify "non-plenum" rating requirements.
- F. Cable that is run open above a suspended ceiling shall be supported by either a cable tray, channel, or hangers, as accepted. Do not lay low-voltage open wire cables in the joist or on ductwork, piping and plumbing systems, or on top of the lay-in ceiling tiles.
- G. Cable shall be routed above the bottom of all metal framing such as floor joists or trusses for the next floor or roof above.
- H. Cables shall be supported by rings and bails and shall be neatly bunched, bundled, and tied together, and routed above the bottom of the joist, with supports mounted from the bar joist or truss.
- I. Cables shall not be supported from ductwork, piping, plumbing systems, ceiling tile and lighting fixture suspension wires, or building structure.

- J. Low-voltage open wiring shall not be routed in or through data/ telecommunication or other cabling raceways, conduits, cable trays, sleeves, etc. The Contractor shall provide a dedicated raceway system for this system installation, unless noted otherwise.
- K. Cables and wiring routed above an accessible ceiling may be run as “open wiring,” unless noted otherwise.
- L. Cables and wiring routed through open ceiling commercial/industrial spaces shall be routed in conduit, enclosed wireway, or cable tray, unless noted otherwise.
- M. All low-voltage wiring exposed below the bottom of the joist line shall be enclosed in conduit or other raceway system.
- N. Maximum allowable spacing between cable/wiring supports (rings, bails, etc.) shall be 60 inches.
- O. Plenum-rated cable ties and cable supports must be utilized in all plenum-rated spaces. Electrical tape is not acceptable as a cable tie, and cable ties are not acceptable as cable supports.
- P. All cables shall be free of tension at both ends, as well as over the entire length of the run.
- Q. Cable ties and supports shall not pinch, bind, crimp, or in any way cause physical or electrical characteristic damage to the cabling.
- R. The Contractor shall assure that during and upon completion of the installation, all cables are free of kinks, sharp bends, twists, gouges, cuts, or any other physical damage.
- S. For those locations where cables pass through metal studs, the Contractor shall install a bushing or grommet in all metal studs to prevent damage to the cables.
- T. Cables routed above non-accessible ceiling areas, or in open areas subject to abuse, shall be routed in conduit or other suitable raceway, subject to acceptance by the Architect.
- U. Cables shall be routed and supported away from the building structure and system components, with a minimum clearance of 3 inches.

END OF SECTION

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SECTION 28 05 93

TESTING OF DUCT DETECTORS & SMOKE/FIRE DAMPERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Unless otherwise noted in Division 23 of the specifications, this section covers the testing requirements for duct smoke detectors and smoke/fire dampers. The fire alarm supplier shall include third-party certification of the proper operation of these components as described herein.
- B. The third-party testing company shall be an AABC or NEBB certified Technical Air Balance company. Technicians performing testing qualified as "Special Inspections" shall be recognized by the local Authority Having Jurisdiction (AHJ) for said testing.

1.2 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TAB Specialist: An entity engaged to perform TAB work.

1.3 SUBMITTALS

- A. Contractor Qualifications: Include AABC or NEBB certificates for proposed personnel, and test instrument certifications.
- B. Certified TAB reports.
- C. Sealed special inspection reports.

1.4 QUALITY ASSURANCE

- A. Supervising technicians and firm shall be AABC or NEBB certified.
- 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 TAB plan and the procedures specified and referenced in this specification.
- C. TAB Report Forms: Use standard TAB Contractor's forms.
- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, Instrumentation.
- E. Perform special inspections as required herein and by the AHJ.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TESTING FIRE AND SMOKE CONTROL DEVICES

A. Perform all work as described below:

1. Record manufacturer and model number for each fire damper, duct smoke detector, smoke damper, and combination fire/smoke damper.
2. Duct Mounted Smoke Detectors:
 - a. Verify the proper operation of the smoke detector using a test gas, "canned smoke," acceptable to the AHJ or Engineer. Magnets are not acceptable.
 - b. Test airflow using a micromanometer and record differential pressure across the sampling tube and the exhaust tube to verify if the differential pressure is within the listed range of the device.
 - c. Verify if the activation of the smoke detector closes the appropriate smoke or combination fire/smoke damper(s) and/or de-energizes the appropriate air-moving device(s).
 - d. Verify if the activation of the smoke detector is annunciated at the fire alarm system and verify if the fire alarm audiovisual devices are activated.
3. Smoke and Combination Fire/Smoke Dampers: Verify that dampers controlled by an Area Coverage Smoke Detection System operate correctly on a signal from the system.
4. Air-Moving Device Shutdown: Verify that air-moving device(s) that are to be de-energized by an Area Coverage Smoke Detection System de-energize on a signal from the fire alarm system.
5. After all smoke control devices have been successfully tested, the TAB firm shall engage the services of a Professional Mechanical Engineer, registered in the State of Arizona, to submit a signed and sealed report attesting to the proper operation of the smoke control devices and air-moving device shutdowns.
6. Submit sealed report to the Architect and the AHJ.

END OF SECTION

SECTION 28 46 00

FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 SUMMARY

- A. The work covered by this section of the specifications includes the furnishing of all labor, equipment, materials, and performance of all operations in connection with the extensions/modifications of the existing fire alarm system as shown on the drawings and as herein specified.
- B. The vendor shall submit, as herein described, detailed shop drawings, equipment, and device data sheets to the Architect for acceptance. Once accepted, submit to the Fire Marshal's office for review and approval. Once the Fire Marshal has approved, installation may proceed. No allowance shall be made for non-conforming work installed prior to Fire Marshal approval.
- C. The Contractor may install conduit, wire, and outlet boxes, but all equipment shall be installed and connected by an experienced and accredited specialist. The Contractor shall be responsible for having the system installer:
 - 1. Make Fire Marshal submissions.
 - 2. Furnish four sets of schematic diagrams, operating and maintenance information to the Owner after installation.
 - 3. Check and inspect system to the Architect's satisfaction.
 - 4. Instruct the Owner's personnel in the operation and maintenance of the system.
 - 5. Certify that the Contractor maintains a fully equipped service organization capable of furnishing inspection and service to the system and that the Contractor is prepared to offer the Owner a service contract for system maintenance after the guarantee period.
 - 6. Guarantee the performance of the system for the warranty period, starting from the date of Substantial Completion, and make all changes necessary to meet the required performance without additional cost to the Owner.

1.2 PLANS AND SPECIFICATIONS

- A. If any departures from the drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore shall be submitted to the Architect for review. No departures shall be made without prior acceptance of the Architect.
- B. The interrelation between the specifications and the drawings is as follows: The specifications determine the nature and setting of the materials; the drawings establish the quantities, dimensions, and details; and the schedules give the performance characteristics.
- C. If conflicting information is found either within the drawings or between the drawings and the specifications, the better quality of work or materials shall be estimated upon and, unless otherwise directed by the Architect in writing, shall be performed or furnished. If the specifications do not fully agree with the drawings, the drawings shall govern.
- D. Items specifically mentioned in the specifications but not shown on the drawings and/or items shown on the drawings but not specifically mentioned in the specifications shall be installed by the Contractor under the appropriate section of work as if they were both specified and shown.

1.3 CODES AND STANDARDS

- A. The system shall comply with the applicable provisions of the current NFPA 72 Standards, local building codes, and all requirements of the local Authorities Having Jurisdiction (AHJ). The system shall be listed, labeled, or approved by Underwriters Laboratories, Inc. (UL). The system shall also meet the requirements of the State Fire Marshal's Office, State Administrative Codes, and the AHJ.
- B. NFPA Compliance: Provide fire alarm and detection systems conforming to the requirements of the current editions of the following publications:
 - 1. NFPA 72 - Installation, Maintenance, Testing, and Use of Local, Auxiliary, Remote Station, and Proprietary Protective Signaling Systems.
 - 2. NFPA 72E - Automatic Fire Detectors.
 - 3. NFPA 101 - Life Safety Code.
- C. Electrical Component Standard: Components and installation shall comply with the Americans with Disabilities Act (ADA) and NFPA 70, National Electric Code (NEC), Article 760.
- D. In any instance where these specifications call for materials for construction of a better quality or larger size than required by the codes, the provisions of these specifications shall take precedence. The codes shall govern in case of direct conflict between the codes and the drawings.

1.4 QUALITY ASSURANCE

- A. Each and every item of the fire alarm system shall be listed as a product of a single fire alarm system manufacturer under the appropriate category by UL, and shall bear the UL label. All control equipment shall be listed under UL Category UOJZ as a single control unit. Partial listing shall not be acceptable.
- B. UL Listing and Labeling: The systems and all components shall be listed by UL, for use in fire protective signaling systems under the following standards, as applicable.
 - 1. UL 38 - Manually Activated Signaling Boxes.
 - 2. UL 217 - Smoke Detectors for Single Station.
 - 3. UL 228 - Door Holders for Fire Protective Signaling Systems.
 - 4. UL 268 - Smoke Detectors for Fire Protective Signaling Systems.
 - 5. UL 268A - Smoke Detectors for Duct Applications.
 - 6. UL 346 - Waterflow Indicators for Fire Protective Signaling Systems.
 - 7. UL 464 - Audible Signaling Appliances.
 - 8. UL 521 - Heat Detectors for Fire Protective Signaling Systems.
 - 9. UL 864/UOJZ, APOU - Control Units for Fire Protective Signaling.
 - 10. UL 1481 - Power Supplies for Fire Protective Signaling Systems.
 - 11. UL 1971 - Visual Signaling Appliances.
 - 12. UL 1711 - Amplifiers for Fire Protective Signaling Systems.
- C. All control equipment shall have transient protection devices to comply with UL 864 requirements.
 - 1. Where not existing, provide transient protection at all power input circuits.
 - 2. Where fire alarm circuits leave any buildings, transient suppression devices shall be provided for each circuit.

- D. In addition to the UL Category UOJZ requirement mentioned above, the system controls shall be UL Listed for power limited applications per NEC 760. All circuits must be marked in accordance with NEC 760.10.
- E. All fire alarm equipment shall be provided by the manufacturer's factory-authorized distributor in the State of Arizona.

1.5 GENERAL

- A. Furnish and install devices indicated and connect them to the existing fire alarm system. Provide necessary programming to include added devices and functions.
- B. New devices shall match and be compatible with the existing fire alarm system devices. Each component shall display the manufacturer's name and shall be provided by the manufacturer's factory-authorized distributor in the State of Arizona.
- C. Expansion zones shall be provided as addressable loop(s) routed through insert site-specific routing and/or instructions. Provide a new addressable zone card for the fire alarm control panel (FACP). Provide an additional remote annunciator for the system as shown/noted on the drawings.

1.6 ACTION SUBMITTALS

- A. Submit the following drawings and technical data for review by the Architect for acceptance:
 - 1. Fully prepared shop drawing set, including scaled floor plan layout drawings, detailed shop drawings, voltage drop and battery calculations, and wiring and connectivity diagrams.
 - 2. Equipment and device data sheets.
 - 3. A document certifying that the vendor maintains a fully equipped service organization capable of furnishing inspection and service to the system.
 - 4. A document indicating that the vendor is prepared to offer the Owner a service contract for system maintenance after the guarantee period.
- B. Submit the following drawings and technical data for review by the Fire Marshal for approval:
 - 1. Fully prepared shop drawing set, including scaled floor plan layout drawings, detailed shop drawings, voltage drop and battery calculations, and wiring and connectivity diagrams.
 - 2. Equipment and device data sheets.
 - 3. Engineer of Record drawing set showing device locations, general concept riser diagram, and design specifications.

1.7 GUARANTEE

- A. The Contractor shall warrant the programming revisions and added fire alarm system components, including wiring, to be free from inherent mechanical and electrical defects for a period of 1 year from the date of the completed and certified test or from the date of first beneficial use.

PART 2 - PRODUCTS

2.1 PERIPHERAL DEVICES

- A. Manual stations shall be double action and shall be constructed of cast metal or high impact, red polycarbonate with raised white lettering and a smooth high-gloss finish. To minimize nuisance alarms, activation shall require two separate and distinct actions. Once activated, the station shall provide a visual indication of the station in alarm. Reset shall require a key, common to the control panel.
- B. Heat Detectors:
 - 1. Combination Fixed-Temperature/Rate-of-Rise Heat Detectors: Provide low-profile heat detectors rated for a maximum smooth ceiling rating of 2,500 sq.ft. (232 m2). The detectors shall be finished pure white and have a positive identification for the operation of the fixed-temperature element. The detectors shall be rated at 15°F (9°C) per minute rate-of-rise and 135°F (57°C) fixed temperature.
 - 2. Fixed-Temperature Heat Detectors: Provide low-profile heat detectors rated for a maximum smooth ceiling rating of 2,500 sq.ft. (232 m2). The detectors shall be finished pure white and have a positive identification for the operation of the fixed-temperature element. The detectors shall be rated at 135°F (57°C) fixed temperature.
- C. Duct Smoke Detectors: Duct smoke detectors shall be of the solid-state photoelectric type and UL Listed per UL S911, Standard for Smoke Detectors for Duct Applications, specifically for use in air handling systems. The detectors shall operate at air velocities from 300 feet per minute to 4,000 feet per minute. The detectors shall have an operating temperature range of 32°F to 100°F for indoor applications and 0°F to 150°F for exterior applications, 10% to 93% RH noncondensing. The detectors shall be designed to ignore invisible airborne particles or smoke densities that are below the factory-set alarm point. No radioactive materials shall be used. Detector construction shall be of the split type (housing with integral mounting base plus a twist-lock detecting head). Contacts between the base and the head shall be of the bifurcated type using spring-type, self-wiping contacts. The detectors shall be capable of local testing via a magnetic switch or remote testing station. The duct detector housing shall incorporate an airtight smoke chamber in compliance with UL S911. The housing shall be capable of mounting to rectangular or round ducts up to 12 feet wide without adapter brackets. Sampling tubes shall be installed after the housing is mounted to the duct by passing through the duct housing. Terminal connections shall be of the strip and clamp method suitable for #12 to #18 AWG wiring. Detectors shall have an alarm LED visible through a transparent front cover. Detectors shall obtain their operating power from the supervised current in the fire alarm loop. Provide power relays slave connected to the duct detector AUX relays for control of HVAC fans as required. At each duct smoke detector, provide relay contacts which open on alarm signal from associated duct smoke detector. Contact ratings shall be 24 volts AC, 5 amps. A remote alarm LED indicator/test station shall be provided for each duct smoke detector.
 - 1. Remote LED alarm indicators shall be provided where indicated, and at any location where a detector is installed in a concealed space.
- D. Smoke Detector (Photoelectric): Smoke detectors shall be the solid-state photoelectric type and shall operate on the light-scattering photodiode principle. The detectors shall be designed to ignore invisible airborne particles or smoke densities that are below the factory-set alarm point. No radioactive materials shall be used. Detectors shall have an alarm LED visible through a transparent front cover. Detectors shall obtain their operating power from the supervised current in the fire alarm loop.

- E. Smoke Detector (Beam Type): Projected-beam, single-reflection type smoke detectors listed for operating distances from 16 to 328 feet. Temperature range of -22°F to +131°F. Detectors shall obtain their operating power from the supervised current in the fire alarm loop. Provide power relays slave connected to the duct detector AUX relays for control as required. Contact ratings shall be 24 volts AC, 5 amps. A remote test station shall be provided in an accessible location with each beam detector.
- F. Notification Appliance General Requirements:
1. All appliances which are supplied for the requirements of this specification shall be UL Listed for fire protective service and shall be capable of providing the "equivalent facilitation" which is allowed under the ADA Accessibilities Guidelines, and shall be UL 1971 Listed.
 2. All appliances shall be of the same manufacturer as the specified FACP, to ensure absolute compatibility between the appliances and the control panels, and to ensure that the application of the appliances is done in accordance with the single manufacturer's instructions.
 3. Any appliances that are submitted for use but do not meet the above requirements must show written proof of their compatibility for the purpose intended. Such proof shall be in the form of documentation from each respective manufacturer, clearly stating that the equipment as submitted is 100% compatible with each other for the purpose intended. All wall-mounted strobes shall be provided with lens markings oriented for wall mounting. It shall be possible to replace the lens of any installed strobe in order to facilitate the replacement of a broken lens, or to change the orientation of the lens markings. Removal of an installed strobe to facilitate the changing of a lens shall not be acceptable.
 4. Ceiling-mounted strobes shall have lens markings with correctly oriented lettering.
 5. Appliance finish color shall match existing like devices.
- G. Horns: Low-profile ceiling- or wall-mounted alarm horns shall be polarized and operate on 24 volts DC. Each horn assembly shall include separate wire lead for in/out wiring for each leg of the associated signal circuit. T-tapping of signal device conductors to signal circuit conductors shall not be accepted. The alarm horns shall be suitable for rear mounting behind audiovisual assemblies which shall be flush mounted in a back box and flush trim ring. The device shall have the word "FIRE" in lettering on the sides.
- H. Strobes: Low-profile ceiling- or wall-mounted strobes with "In" and "Out" screw terminals shall be provided for wiring. Strobes shall provide synchronized flash outputs. Strobe output shall be as noted on the drawings. Device shall have a field-selectable candela output of 15 cd, 15/75 cd, 30 cd, 75 cd, 95 cd, or 110 cd. The device shall meet the requirements of the ADA and have the word "FIRE" in lettering on the sides. Strobes shall mount in a North American single-gang box.
- I. Combination Horn/Visual Strobes: Audio and visual characteristics the same as individual devices.
- J. Chimes: Low-profile ceiling- or wall-mounted chimes shall provide an 84 dBA sound output at 10 feet when measured in reverberation room per UL 464. The chime shall have a selectable steady or synchronized temporal output. "In" and "Out" screw terminals shall be provided for wiring. The chime shall mount in a North American single-gang box.

- K. Chime/Strobes: Low-profile ceiling- or wall-mounted chime/strobes shall provide an audible output of 84 dBA at 10 feet when measured in reverberation room per UL 464. Strobes shall provide synchronized flash outputs. Strobe output shall be as noted on the drawings. Where it is not noted, strobe output shall be determined by its specific location and application from a family of 15 cd, 30 cd, 60 cd, 75 cd, 90 cd, and 110 cd devices. The chime shall have a selectable steady or synchronized temporal output. "In" and "Out" screw terminals shall be provided for wiring.
- L. Strobes: Low-profile ceiling- or wall-mounted strobes with "In" and "Out" screw terminals shall be provided for wiring. Strobes shall provide synchronized flash outputs. Strobe output shall be as noted on the drawings. Where it is not noted, strobe output shall be determined by its specific location and application from a family of 15 cd, 30 cd, 60 cd, 75 cd, 90 cd, and 110 cd devices. Low-profile strobes shall mount in a North American single-gang box.
- M. Remote Booster Power Supply: Notification appliance power booster with supervised 8.0-amp power supply. Unit to include sufficient battery capacity to meet the Fire Marshal's requirements, but no less than coverage for a 24-hour power outage with 5 minutes of notification appliance circuit operation at the end of the time period.
- N. Addressable Control Relays: Relays shall be motor rated for control of combination smoke/fire dampers (CSFDs), 120-volt, 5-amp contacts.
- O. Door Holders: Magnetic door holders shall be furnished under this section of the specifications. The armature assemblies shall be wired into the fire alarm system as required. Mounting of door holders shall be accomplished and coordinated by the General Contractor to ensure proper structural support. Coordinate mounting styles (semiflush, surface, flush, etc.) with the Architect prior to ordering. The door holders shall have brushed aluminum finish, operating voltage matching the existing system. The unit shall be supplied and wired by the Electrical Contractor. Provide contacts NO/NC in the FACP to operate door holder circuits upon alarm initiation.
- P. Remote Annunciator: Provide an 80-character LCD screen with silence and reset buttons and key lockout. The annunciator shall be flush mounted in a 5-gang box. The annunciator shall mimic the main FACP fire alarm panel display.

2.2 TRANSIENT PROTECTION

- A. Provide transient protection utilizing inline diode technology surge suppressors with clamping voltage of 330 volts, surge current rating of 7 kA or greater, with a response time of 10 nanoseconds or less.
- B. Manufacturer: DITEK or Engineer-accepted equal.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Provide and install the system in accordance with the plans and specifications, all applicable codes, and the manufacturer's recommendations. All wiring shall be installed in strict compliance with all the provisions of NEC 760 A and C, Power-Limited Fire Protective Signaling Circuits, or if required may be reclassified as non-power limited and wired in accordance with NEC 760 A and B. Minimum wire size shall be #14 AWG, 7-strand for 24 volts DC and #12 AWG, solid for 120 volts AC. All wiring shall be installed in conduit with a minimum 6-foot separation between outgoing and incoming circuits.

1. All junction boxes shall be painted red and labeled "FIRE ALARM." Wiring color code shall be maintained throughout the installation.
- B. All wires shall be tagged at all junction points and shall test free from grounds or crosses between conductors.
- C. Provide reprogramming services to include activation subsequent response programming for added devices.
- D. The fire alarm panel shall be programmed to shut down air handler system(s) when the associated duct smoke detectors are activated. However, the duct smoke detector which exists to control a specific smoke damper shall not shut down the associated air handling system unless specifically required by the building life safety plan.
- E. Confirm that the existing FACP recognizes the new equipment.
- F. Update any graphic system displaying fire alarm system components to the final system configuration.
- G. The manufacturer's authorized representative shall provide onsite supervision of installation.

3.2 EQUIPMENT INSTALLATION

- A. Manual Pull Stations: Mount semi-flush in recessed back boxes at heights noted on the plans, but in no case shall the handle be located higher than 48 inches above finished floor.
- B. Notification Appliances: Install appliances in ceiling or wall positions as shown or noted on the drawings.
 1. Strobe appliances shall be centered where practicable within the space. Corridors and halls shall have a strobe appliance located within 15 feet of the end of the corridor/hall.
 2. Strobe appliances shall be applied within their area of coverage limits per NFPA 72 tables or manufacturer's product literature, whichever is smaller.
 3. Ceiling-Mounted Strobe Appliances: The Contractor shall verify that the candela output of the appliance is adequate for the ceiling height. Provide higher output strobes as required to maintain compliance with NFPA 72 criteria.
 4. Wall mount appliances at heights noted on the plans, but in no case shall the bottom of the device be lower than 80 inches above finished floor to bottom. Wall-mounted appliance locations shall be adjusted and augmented as required by additional appliances where furniture obstructs the function of the specified appliance.
- C. Smoke Detectors: Install ceiling-mounted detectors not less than 4 inches from a sidewall to the near edge. Install detectors located on the wall at least 4 inches but not more than 12 inches below the ceiling. For exposed solid joist construction, mount detectors on the bottoms of the joists. On smooth ceilings, install detectors not over 30 feet apart in any direction. Install detectors no closer than 3 feet from air registers. In all cases, detectors shall be located in accordance with NFPA 72 spacing requirements. Coordinate with the latest architectural ceiling plans for final ceiling conditions.
- D. Projected-Beam Smoke Detectors: Install at ceiling level in accordance with NFPA 72 requirements and the manufacturer's installation instructions.

- E. Smoke Duct Detector Installation: Detectors used in duct applications shall be located in accordance with NFPA 72, NFPA 90A, and manufacturer's recommendations. Where controlling a smoke damper, locate detector within 5 feet of the damper to be controlled. Mount smoke duct detectors as far as possible downstream from duct openings, bends, deflection plates, sharp bends, air diffuser, etc. Smoke duct detectors may be installed closer than 6 duct widths where it is physically impossible to locate them within the 6 to 10 equivalent duct widths, but not less than 2 equivalent duct widths away from duct openings, bends, etc. If it is physically impossible to mount the smoke duct detector in the area greater than 2 equivalent duct widths, install additional smoke duct detectors as necessary.
- F. Locate remote indicators for duct smoke detectors flush in the ceiling and directly below the associated detector.
- G. Remote Annunciator: Arrange as indicated, with the top of the unit in conformance with ADA mounting height criteria.

3.3 WIRING INSTALLATION

- A. Wiring Method: Install wiring in metal raceway according to Specification Section 26 05 33, Raceway & Boxes for Electrical Systems. Conceal raceway except in unfinished spaces and as indicated.
- B. Wiring Within Enclosures: Install conductors parallel with or at right angles to the sides and back of the enclosure. Bundle, lace, and train the conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the wiring diagrams of the system. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- C. Cable Taps: Use numbered terminal strips in junction boxes, pull boxes, outlet boxes, cabinets, or equipment enclosures where any circuit tap is made.
- D. System Wiring: Wire and cable shall be a type listed for its intended use by an approval agency acceptable to the AHJ and shall be installed in accordance with the appropriate articles from the current approved edition of the NEC (NFPA 70). It is the Contractor's responsibility to obtain written instruction from the fire alarm system manufacturer regarding the appropriate wire/cable to be used for this installation. No deviation from the written instruction shall be made by the Contractor without the prior written approval of the fire alarm system manufacturer.
- E. Color Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm initiating device circuits wiring and a different color code for supervisory circuits. Color-code notification appliance circuits differently from alarm-initiating circuits. Paint fire alarm system junction boxes and covers red.
- F. Fan Shutdown: Air handling equipment shall be connected to fire alarm system control relays. Where duct smoke detectors are installed, provide air handling equipment control via mechanical equipment's respective duct smoke detector.
- G. Smoke Dampers: Where the building smoke detection system is providing full area coverage, dampers shall be controlled from locally-mounted fire alarm system control relays. The control method shall conform to IBC 716.3.2.1.

3.4 MECHANICAL EQUIPMENT FAN SHUTDOWN CONTROL

- A. At air handling equipment with design capacity greater than 2,000 cfm, provide duct smoke detectors in the return air system (IMC), upstream of any filters, exhaust air connections, outdoor air connections, or decontamination equipment and appliances and main supply air duct (UMC), downstream of unit air connection.
 - 1. Exception: Duct smoke detectors are not required in the air system where the space served by the air distribution system is protected by a complete system of area smoke detectors in accordance with building code.
- B. Multiple air handling systems share common supply or return air ducts or plenums with an aggregate design capacity greater than 2,000 cfm. The return air system (IMC) and supply air system (UMC) shall be provided with individual duct smoke detectors at each unit or full coverage area smoke detection system or return plenum-mounted area smoke detectors within the area served by the air handling system.
 - 1. Provide a control module at each piece of air handling equipment to be controlled. Upon activation of air handler smoke detection system, the fire alarm panel shall activate the control module for air handling unit shutdown.
- C. Return Air Designs with Capacity greater than 15,000 cfm and Serving more than One Story: Provide a duct smoke detector at each story, in the return air duct, upstream (air-wise) of recirculation and outdoor air connections.

3.5 SMOKE DAMPER CONTROL

- A. Smoke damper actuation shall be achieved by one of the following methods. In all methods, smoke dampers occurring within an air handling system shall close upon activation of the fan shutdown controls. Installations shall meet the requirements of UBC 713.10 or IFC 715.3.2.1, as applicable.
 - 1. Corridor Walls or Ceilings: Smoke dampers penetrating corridor walls shall receive power from a single 120-volt circuit, controlled by a normally closed contact which is responsive to the detection of smoke in the corridor. Provide an addressable heavy-duty control relay (120-volt, 30-amp contacts) or multiple relays as needed. Upon activation of any of the associated corridor smoke detectors, the control relay shall remove power from the damper circuit, causing dampers in the corridor walls to close. The addressable control relay may power multiple smoke dampers, up to circuit limit of 12 amps on a 120-volt, 20-amp circuit. Smoke dampers occurring within an air handling system shall close upon activation of the fan shutdown controls.
 - 2. Non-Corridor Walls, Floors, and Shafts: Install multiple voltage, 120-volt, 1-amp rated, addressable control relay at each smoke damper. Locate a duct smoke detector within 5 feet on either side of the damper. Upon activation of this smoke detector, the control relay shall remove power from the damper, causing it to close. Smoke dampers occurring within an air handling system shall close upon activation of the fan shutdown controls.
 - 3. Non-Ducted Openings: Install multiple voltage, 120-volt, 1-amp rated contacts, addressable control relay at each smoke damper. Locate a spot-type smoke detector within 5 feet horizontally on either side of the opening. Upon activation of this smoke detector, the control relay shall remove power from the damper, causing it to close. The smoke detector shall be listed for releasing service.

4. Corridor Walls or Ceilings: Smoke dampers penetrating corridor walls shall receive power from a single 120-volt circuit, controlled by a normally closed contact which is responsive to the detection of smoke in the corridor. Provide an addressable heavy-duty control relay (120-volt, 30-amp contacts) or multiple relays as needed. Upon activation of any of the associated corridor smoke detectors, the control relay shall remove power from the damper circuit, causing dampers in the corridor walls to close. The addressable control relay may power multiple smoke dampers, up to circuit limit of 12 amps on a 120-volt, 20-amp circuit. Smoke dampers occurring within an air handling system shall close upon activation of the fan shutdown controls.
5. Non-Corridor Walls, Floors, and Shafts: Install multiple voltage, 1 amp rated, addressable control relay at each smoke damper. Upon activation of any smoke detector in that smoke compartment or an adjacent smoke compartment, the control relay shall remove power from the damper, causing the damper to close.
6. Non-Ducted Openings: Install multiple voltage, 120-volt, 1-amp rated contacts, addressable control relay at each smoke damper. Locate a spot-type smoke detector within 5 feet horizontally on either side of the opening. Upon activation of this smoke detector, the control relay shall remove power from the damper, causing it to close. The smoke detector shall be listed for releasing service.

3.6 GROUNDING

- A. Ground equipment and conductor and cable shields as specified by the equipment manufacturer. Provide 5-ohm ground at main equipment location. Measure, record, and report ground resistance.

3.7 FIRE ALARM RECORD DRAWINGS CABINET

- A. Where not existing, provide a record drawings cabinet and locate it at the FACP location. Where the FACP is located in a public space, locate the cabinet in the fire riser room. Provide a permanently affixed label on the cabinet exterior stating, "FIRE ALARM RECORD DRAWINGS."

3.8 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Provide the services of a factory-authorized service representative to supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system.
- B. Pretesting: Upon completing installation of the system, align, adjust, and balance the system and perform complete pretesting. Determine, through pretesting, the conformance of the system to the requirements of the drawings and specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.
- C. Report of Pretesting: After pretesting is complete, provide a letter certifying that the installation is complete and fully operable, including the names and titles of the witnesses to the preliminary tests.
- D. Final Test Notice: Provide a 10-day minimum notice in writing when the system is ready for final acceptance testing.
 1. The completed fire alarm system shall be fully tested in accordance with NFPA 72, Chapter 7, and local AHJ requirements. All tests shall be performed by the Contractor, in the presence of the Owner's representative and the local Fire Marshal. Upon completion of a successful test, the Contractor shall so certify in writing to the Owner and the General Contractor.

- E. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the specifications and complies with applicable standards.
- F. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log. Submit log upon the satisfactory completion of tests.
- G. Tag all equipment, stations, and other components at which tests have been satisfactorily completed.
- H. Final Test, Certificate of Completion, and Certificate of Occupancy: Test the system as required by the AHJ in order to obtain a certificate of occupancy. Demonstrate that the system meets the specifications and complies with applicable standards. This final test shall be witnessed by a representative of the AHJ and a factory-authorized service representative.
- I. The Contractor and/or the system manufacturer's representatives shall provide a typewritten "Sequence of Operation."
- J. Update fire alarm system record drawings and sequence of operation and place them in the system cabinet. Identify the following information on record documents:
 - 1. The name of the modifying vendor company and their contact information.
 - 2. Date of changes.

3.9 CLEANING AND ADJUSTING

- A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean unit internally using methods and materials recommended by the manufacturer.
- B. Occupancy Adjustments: When requested within 1 year of date of Substantial Completion, provide onsite assistance in adjusting sound levels and adjusting controls and sensitivities to suit actual occupied conditions. Provide up to three visits to the site for this purpose.

3.10 TRAINING

- A. Provide the services of a factory-authorized service representative to demonstrate the system and train the Owner's maintenance personnel as specified below.
 - 1. Train the Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventive maintaining of the system. Provide a minimum of 4 hours of training.
 - 2. Schedule training with the Owner at least 7 days in advance.

3.11 SERVICE SUPPORT

- A. The system vendor shall employ factory-trained technicians and maintain a service organization within 75 miles of the project site. A maintenance proposal, including system monitoring, shall be presented to the Owner with the closeout package. Provide operating instructions to the Owner.

END OF SECTION

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SECTION 28 46 24.23

FIREFIGHTER'S SMOKE CONTROL STATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Firefighter's smoke control station for visualization and manual control of the building's smoke control systems.

1.2 SUBMITTALS

- A. Product Data: Provide manufacturer's product data for each component that will be included in the final assembly, including switches, indicator lights, cabinet, connectors, and labeling. Product data shall include materials of construction, assembly methods, dimensions, and other pertinent information.
- B. Shop Drawings: For the project-specific control station. Include the following as a minimum:
 - 1. Detailed elevations of front panel graphics, cabinet sections, and attachments to other work.
 - 2. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Wiring Diagrams: For power, signal, and control wiring.
 - 4. Coordination: Control station interface shall be coordinated with fire alarm system.
- C. Field Test Reports: Indicate and interpret test results for each switch and indicator.
- D. Field quality-control reports.
- E. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. UL Listed: Panel shall be UL 864, Category UUKL Listed as a Firefighter's Smoke Control Override Station.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Product: Subject to compliance with requirements, provide product indicated on drawings or a comparable product by one of the following:
 - 1. Automation Displays, Inc.
 - 2. H.R. Kirkland Company.
 - 3. Light Engineered Displays, Inc.

2.2 MANUFACTURED UNIT

- A. Description: Factory-assembled and -tested firefighter's smoke control station consisting of color graphics, indicator lights, and manual switches to visualize and control the smoke control system.
- B. Cabinet: Steel cabinet suitable for recessed, semi-recessed, or surface mounting as indicated. Cabinet shall have welded and ground seams and be powder coated after fabrication.
 - 1. Provide a protective, key-lockable cover over the front of the control station to prevent tampering. Label the cover "Firefighter's Smoke Control Station."
- C. Graphics:
 - 1. Graphics shall be full color with equipment and dampers shown in black, exhaust airflow paths shown in red, and supply airflow paths shown in green. Arrows integral with the flow paths shall be provided to indicate direction of airflow.
 - 2. Graphics shall be applied to the back of a clear plastic faceplate to prevent fading or damage.
 - 3. Graphics shall represent the layout of the building and the components and equipment of the smoke control system.
- D. Indicator Lamps: Light-emitting diode style indicator lamps shall be provided for each damper and piece of equipment to show status. Red shall be used to show "Off" or "Closed" and green shall be used to show "Open" or "On." Provide a pushbutton test switch that illuminates all lights when depressed.
- E. Manual Control Switches: Three-position switches shall be provided for each damper and piece of equipment. The switch positions shall be "Open," "Auto," and "Closed" for dampers and "On," "Auto," and "Off" for equipment.
- F. Power Requirements: 120 volts AC; with electrical contacts for connection to system components, and transformer or rectifier as needed to produce power at voltage required for accessories and control devices.
 - 1. Provide local means to disconnect power to panel and internal components.

2.3 SEQUENCE OF OPERATION

- A. Sequence of Operation: Refer to the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Wall-Mounting Controllers: Install control station recessed or on wall. Install to allow for observation and operation of all indicator lights and switches. Top of control station shall not be more than 79 inches above finished floor.
- B. Floor-Mounting Controllers: For controllers not on walls, provide freestanding racks constructed of welded steel members or bolted strut framing systems. Racks shall be constructed in a workmanlike manner with ground welds, mitered corners, etc., and shall be painted black after fabrication.

3.2 WIRING

- A. Connect electrical devices to control station and to building's fire alarm system.

END OF SECTION

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